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Sydney Tar Ponds Clean Up sampling program

ACRES INTERNATIONAL LIMITED

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SYDNEY TAR PONDS CLEAN UP

SAMPLING PROGRAM

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1 - INTRODUCTION

Acres International Limited (Acres) was commissioned by the Nova Scotia Department of the Environment (NSDOE) to provide project management services for the cleanup of the Tar Ponds at Sydney, Nova Scotia.

As part of the design work for the excavation and incineration of PAH-contaminated sediments from Muggah Creek (Tar Ponds), additional information on the extent, the physical and chemical characteristics of these sediments and their properties as a fuel were required. Information on the characteristics of the underlying bed materials was also needed in terms of the conceptual plan for removal of the contaminated sediments.

Accordingly, an investigation involving the drilling of boreholes, soil testing and sample collection was carried out by Acres during the months of September and October 1987. This report provides a summary of the field work and related sediment analyses. Chapter 2 describes the study area and briefly summarizes the results of previous work while Chapter 3 outlines the details of the field program. Collating the results of this and earlier investigations, Chapter 4 describes the conditions of the Tar Ponds.

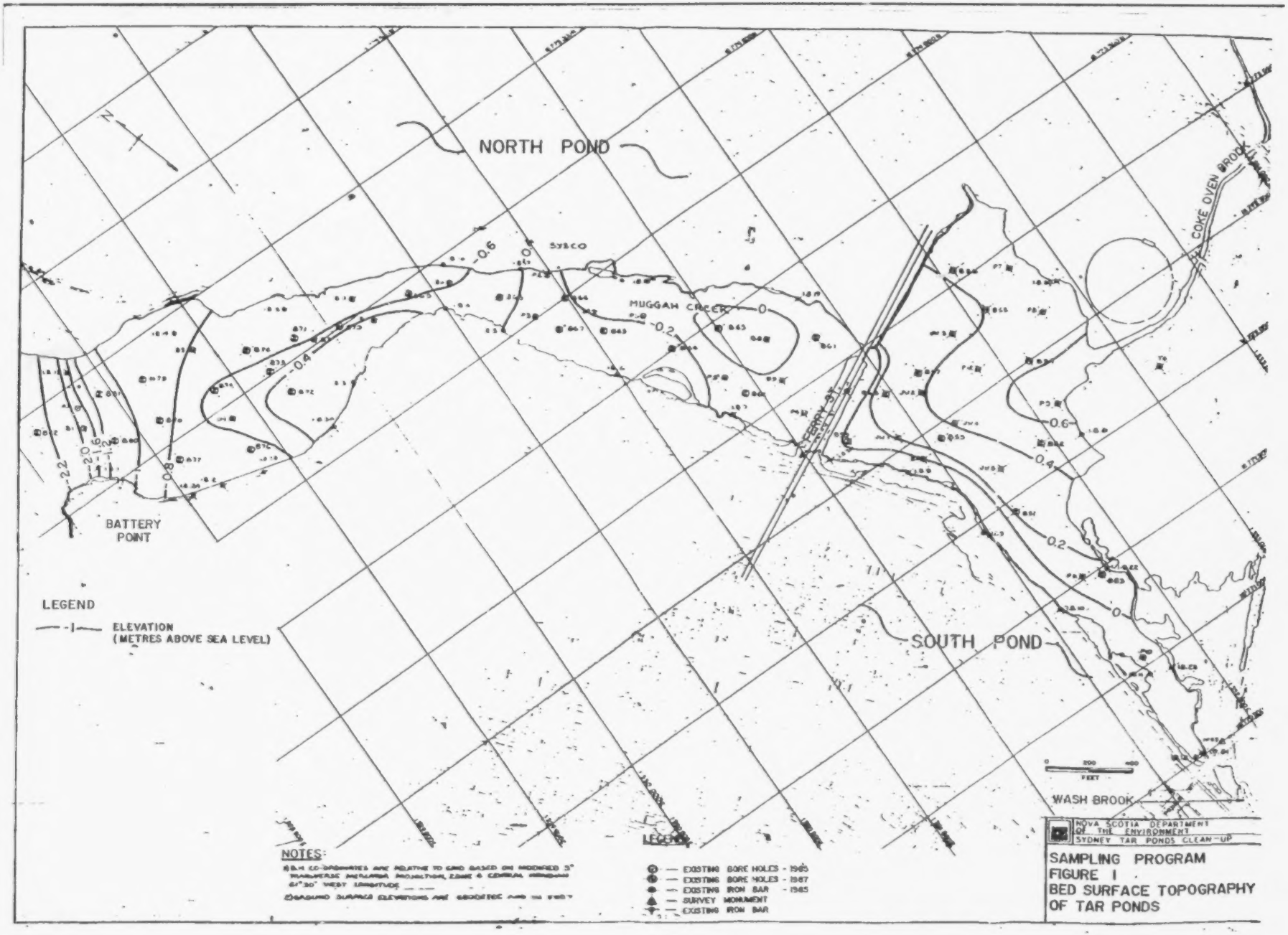
2 - STUDY AREA AND PREVIOUS WORK

The lower portion of Muggah Creek covers an area of about 33 ha from its mouth at the South Arm of Sydney harbor to Prince Street and the outlet of Coke Oven Brook to the southeast. It is divided into two parts by the Ferry Street bridge--an inner part designated the South Pond and an outer part designated the North Pond.

The South Pond is deltaic in shape between the outlet of Coke Oven Brook and the Ferry Street bridge (see Figure 1). Several distributory channels direct discharge from Coke Oven Brook to the outlet of the South Pond at the bridge while flow from Wash Brook, the other major tributary, passes through a weakly defined channel along the southwest shore. Although the South Pond is entirely submerged at spring high tide, it is partially exposed most of the time.

The North Pond consists of two distinct parts. A relatively narrow upper half extending from Ferry Street bridge to a prominent constriction about 600 m downstream of the bridge, and a wider lower half between this constriction and the mouth of Muggah Creek at Battery Point. Flow entering the upper half is largely diverted along the southwest shore by a bar centered some 150 m downstream of the bridge. Once flow passes this bar the main channel crosses the upper half and continues its course along the northeast shore. The bar and part of the bed upstream of the constriction is exposed at low tide. The lower half of the North Pond is the deepest part of Muggah Creek and, with the exception of some flats below the constriction along the southwest shore, remains submerged at all times.

The elevation of the bed of Muggah Creek between Coke Oven Brook and the mouth varies by about 3 m. The property adjacent to the southwest shore of both the South and North Ponds is occupied by a Canadian National railway yard while the northeast shore of the North Pond, owned by the Sydney Steel Corporation (Sysco), has and continues to be


NORTH POND
SYSCO
MUGGAH CREEK
FERRY ST.
COKE OVEN BROOK
BATTERY POINT
SOUTH POND
WASH BROOK
LEGEND
ELEVATION
(METRES ABOVE SEA LEVEL)
NOTES:
LEGEND
EXISTING BORE HOLES - 1985
EXISTING BORE HOLES - 1987
EXISTING IRON BAR - 1985
SURVEY MONUMENT
EXISTING IRON BAR
NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT
SYDNEY TAR PONDS CLEAN-UP
SAMPLING PROGRAM
FIGURE 1
BED SURFACE TOPOGRAPHY
OF TAR PONDS

used for the disposal of slag and other materials. This disposal over the years has led to both infilling and a buildup of the northwest shore of Muggah Creek. The east shore of the South Pond is unused with the exception of a building and a cooling pond near Ferry Street.

Historically, loss of coal, coke fines and various coking by-products into Coke Oven Brook has resulted in transport and settling out of this material along Muggah Creek. In an earlier study of the Tar Ponds (Acres, 1985) it was estimated a total volume of about 765,000 m^3 of contaminated sediment overlies the original bed materials of Muggah Creek. This estimate was based on 31 boreholes drilled in the Tar Ponds. About one-third of this material was considered to lie in the South Pond with the remainder in the North Pond. The thickness of the contaminated sediments sampled varied from about 0.5 m to greater than 4 m. The coal and coke particles ranged from coarse gravel to clay in size with most lying in the fine sand size and smaller classes.

3 - FIELD PROGRAM

A total of 32 boreholes were drilled into the bed of Muggah Creek between September 12 and 29, 1987. These boreholes were numbered B51 to B59 and B61 to B83 inclusive, the locations of which are shown on Plate 1 (Borehole Plan, Drawing No. 8186-B-101 - back pocket).

All drilling operations were carried out by Logan Geotech Inc. of Stewiake, Nova Scotia under the direction and supervision of Acres personnel. With the exception of boreholes B56 and B83 which were advanced by hand (due to restrictive site conditions), all boreholes were drilled using a CME 55. For all boreholes situated in the North Pond and half of the boreholes drilled in South Pond, the drill rig was mounted on a 5.5 by 6.1 m barge. For boreholes B52, B54 and B55 which were positioned along the more exposed upper portion of the South Pond, a Bombardier muskeg carrier was used to transport the drill rig.

At each borehole, standard penetration tests were performed and ~~soil~~ sediment samples collected continuously in unconsolidated materials using a split tube sampler. To prevent sloughing, the borehole was advanced by wash boring using NW size casing. In general, sample recovery was good to excellent irrespective of grain size. In the contaminated material this recovery was assisted by binding of the sediments with the tars and oils contained within them. All soil samples were examined and logged in the field, wrapped in aluminum foil, and then sealed in plastic bags and stored in ice chests. At the end of each working day the samples were transferred to a refrigerator (4 deg C). Due to the corrosive nature of the contaminated sediments these materials were later transferred to glass jars. The split tube sampler itself was thoroughly scrubbed and washed on site between each sampling operation. Tars adhering to the side wall of the sampler were readily removed during cleaning.

In bedrock, core samples were obtained using a V series B size diamond drill core barrel. Core recovery was very poor with the exception of three boreholes near the mouth of Muggah Creek where good recovery was obtained. All cores were carefully placed in a core box, examined in the field and labeled. Following the completion of each borehole the drill rig was moved a few meters to one side of the hole. Additional samples of the contaminated sediment were then collected using the split spoon sampler in order to supplement the amount of borehole material for testing purposes.

At the conclusion of the drilling operation, the drill rig, barge, muskeg carrier and all associated equipment were steam cleaned along the southwest shore of the South Pond near Ferry Street with the wash water returned to the South Pond.

The location and ground surface elevation of each borehole were later surveyed by Acres personnel. Details of the borehole logs are provided in Appendix A.

Shortly after the start of the drilling program two representative samples were selected for evaluating PAH destruction. Samples from boreholes B70(-1) and B79(-5) were shipped to Dearborn Chemical Company Limited at the Wastewater Technology Centre in Burlington, Ontario and were labeled as sample Nos. 1 and 2 respectively. The results from this testing are provided in a separate report entitled "Thermal Destruction Data, Phase I", (November 1987).

Following the completion of field work, twelve representative samples of the contaminated sediment were selected for analysis of their chemical and thermal characteristics. OceanChem Group and Nova Scotia Research Foundation Corporation both of Dartmouth, Nova Scotia provided these respective services. Following receipt of the initial test results, 19 additional samples of the contaminated sediment and three samples of sediment taken immediately below the tar pond materials were

similarly analyzed. Details of the results not provided in summary tables in this report are given in Appendix B and C.

Table 3.1 is a reference chart summarizing the location and various sample numbers used for the soil samples analyzed.

TABLE 3.1

SAMPLE NO. REFERENCE CHART

Borehole No.	Acres Chemical/Thermal Sample No. (TP#-) -1 0.00 - 0.61 Chemical	Thermal	-2 0.61 - 1.22 Chemical	Thermal	-3 1.22 - 1.83 Chemical	Thermal	-4 1.83 - 2.44 Chemical	Thermal	-5 2.44 - 3.05 Chemical	Thermal
51	114	115								
52					101-C	101-F				
53			116	117						
54	118	119			102-C	102-F				
55										
56	120						103-C	103-F		
57	104-C	104-F	121	122						
58										
59	144						123		147*	
61			124	125						
63	106-C	106-F								
66	126	127			106-C	106-F	107-C	107-F		
							149		142*	
67	128								143*/145/146	
69	139/140/141	137/138								
70	129+		105/109-C	105/109-F						
72	130	131								
74	110-C	110-F								
75			132				133	134		
76			111-C	111-F	148*					
77	135									
79			150	151	112-C	112-F			113-C+	113-F
83	136									

Acres Geotech Sample No.
Depth Interval (m)
Analysis Type

1 - Chemical samples nos. designated with a letter -C (101 to 113) include analysis of HNC's in addition to PAH's and selected Metals.

2 - Sample nos. designated with a * refer to analysis of a sample subset.

3 - Sample nos. separated with a / refer to blind samples.

4 - Sample nos. designated with a + include PAH destruction testing.

4 - TAR POND CONDITIONS

Three distinct unconsolidated deposits were encountered in the Tar Ponds. These consist of PAH-contaminated granular materials and fines overlying organic clayey silts and/or till. The deposits in turn overlie sandstone and claystone bedrock. Each stratum is described in the following sections, beginning with the bedrock.

4.1 - Bedrock

Most of the boreholes drilled near the mouth of Muggah Creek were advanced through overburden into the underlying bedrock. Borehole B58 in the South Pond was also drilled into bedrock.

Two rock types were encountered. One type was a dark reddish brown claystone which was found to be slightly weathered and moderately weak, with relatively closely-spaced bedding planes. The other type was a dark greenish to grayish brown siltstone. The siltstone varied from weak and highly weathered to strong and fresh, with more widely spaced bedding planes.

At the mouth of Muggah Creek near the Battery Point pier, bedrock was encountered at relatively shallow elevations (about -1.5 m asl). Across the mouth, towards the north shore of Muggah Creek, bedrock elevation gradually declined to below -4 asl.

4.2 - Till

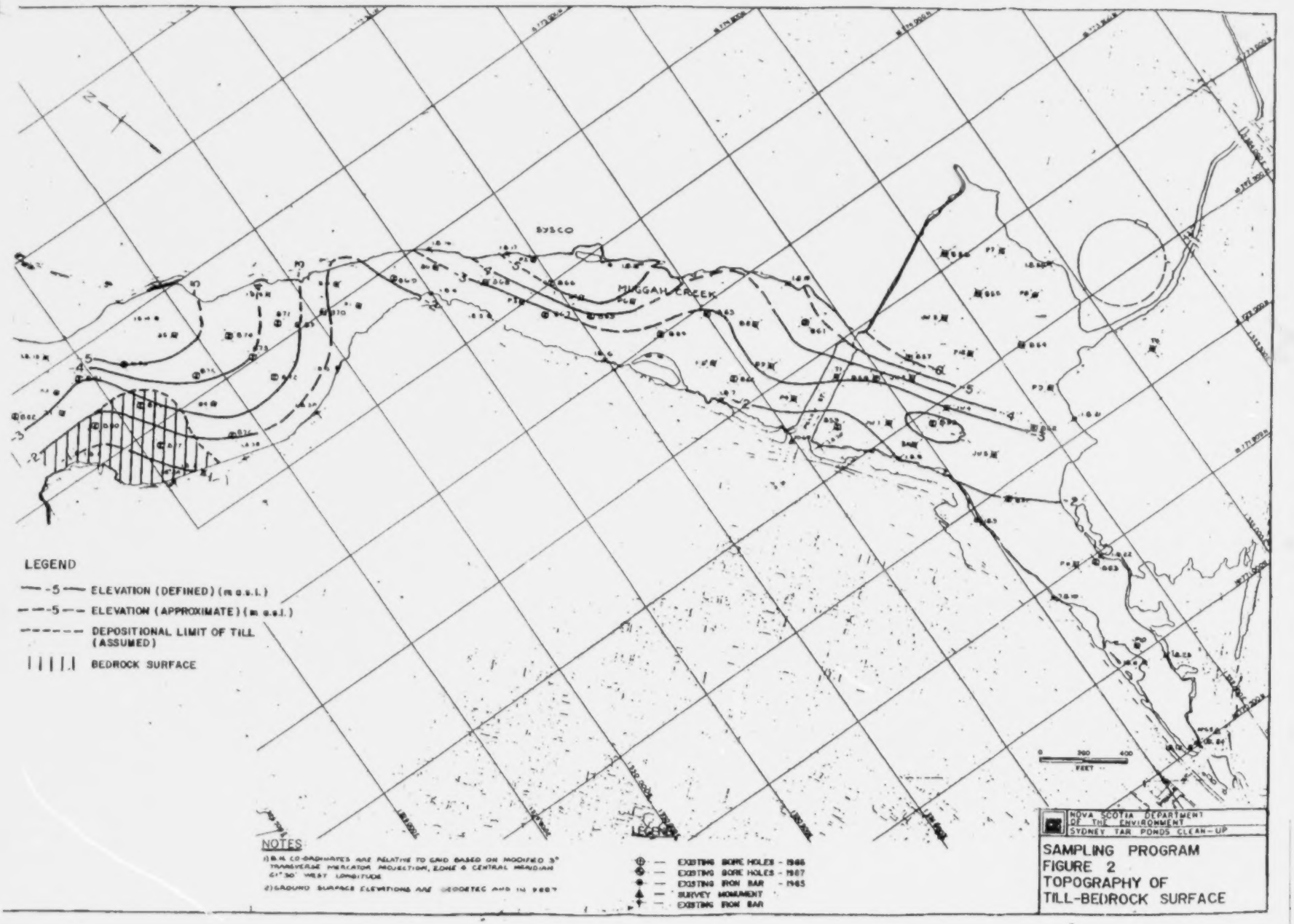
With the exception of the area adjacent to the Battery Point pier, till occurs as a basal deposit beneath the Tar Ponds. Till was absent at the mouth of Muggah Creek near the above-noted pier.

At the site till consists of a light reddish to grayish brown variable mixture of gravels, sands, silts and clays. The till is usually a dense to very dense gravelly or sandy silt with some clay, locally grading to a stiff to hard clayey silt with some gravels and sand. Locally, cobble to boulder sized materials were encountered. However, they are considered to form only a minor component of the overall deposit and are likely confined to localized pockets or layers.

Figure 2 is a contour map of the top surface of the till beneath the Tar Ponds. In the case of the area near the pier (hatched area) the top surface is bedrock. As can be seen the till in the North Pond forms two deep basins (one centered near Borehole B5 and the other near Borehole B66) separated by a ridge near Borehole B10. Another ridge near Borehole B63 bounds a third basin around Borehole B57 in the South Pond. An elongated knob of till around Borehole B53 occurs along the southwest side of this third basin. All of the basins correspond to areas of greater accumulations of the overlying clayey silt and/or contaminated sediments.

4.3 - Clayey Silt

In most boreholes a very soft, compressible, organic clayey silt with some sand was encountered between the underlying till and overlying contaminated sediments. The clayey silt was dark brown in the South Pond becoming more grayish brown through the North Pond. Shell and wood fragments were present in samples from the upper and lower halves of the North Pond, respectively. The clayey silt tended to occasionally become soft to firm with depth usually associated with decreasing clay content. Also, thin clay or sand-rich layers were sometimes found immediately above or below the clayey silt layer. Figure 3 is a map showing the thickness of this deposit beneath the Tar Ponds. It is not present (hatched area) throughout much of the lower half of the North Pond and also near Borehole B63 where a ridge of the underlying till directly underlies the contaminated sediments. The


SYSCO
MUGGAH CREEK
LEGEND
-5- ELEVATION (DEFINED) (m a.s.l.)
-5- ELEVATION (APPROXIMATE) (m a.s.l.)
DEPOSITIONAL LIMIT OF TILL (ASSUMED)
BEDROCK SURFACE
NOTES
1) B.M. CO-ORDINATES ARE RELATIVE TO GRID BASED ON MODIFIED 3° TRANSVERSE MERCATOR PROJECTION, ZONE 6 CENTRAL MERIDIAN 61° 30' WEST LONGITUDE
2) GROUND SURFACE ELEVATIONS ARE GEODETIC AND IN FEET
LEGEND
EXISTING BORE HOLES - 1986
EXISTING BORE HOLES - 1987
EXISTING IRON BAR - 1985
SURVEY MONUMENT
EXISTING IRON BAR
0 200 400
FEET
NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT
SYDNEY TAR PONDS CLEAN-UP
SAMPLING PROGRAM
FIGURE 2
TOPOGRAPHY OF
TILL-BEDROCK SURFACE

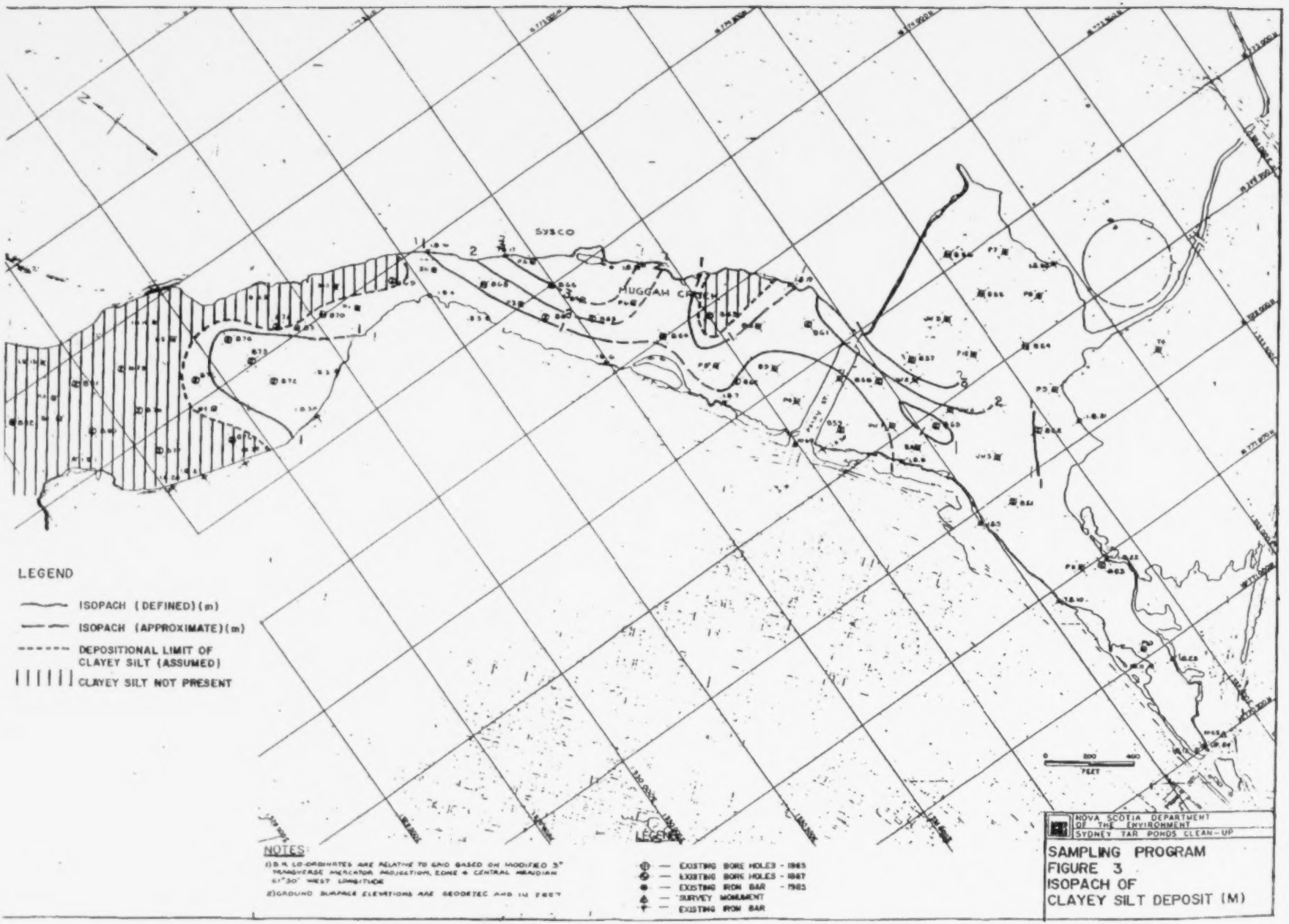

SYSCO
HUGGAH CREEK
LEGEND
ISOPACH (DEFINED)(m)
ISOPACH (APPROXIMATE)(m)
DEPOSITIONAL LIMIT OF CLAYEY SILT (ASSUMED)
CLAYEY SILT NOT PRESENT
NOTES
1) S.M. CO-ORDINATES ARE RELATIVE TO GRID BASED ON MODIFIED 3° TRANSVERSE MERCATOR PROJECTION, ZONE 4 CENTRAL MERIDIAN 61°30' WEST LONGITUDE
2) GROUND SURFACE ELEVATIONS ARE GEODETIC AND IN FEET
LEGEND
— EXISTING BORE HOLES - 1985
— EXISTING BORE HOLES - 1987
— EXISTING IRON BAR - 1985
— SURVEY MONUMENT
— EXISTING IRON BAR
0 800 400
FEET
NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT
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FIGURE 3
ISOPACH OF
CLAYEY SILT DEPOSIT (M)

clayey silt deposit is thickest in the two basins centered near Borehole B66 in the North Pond and Borehole B57 in the South Pond.

4.4 - Contaminated Sediments

In all boreholes the uppermost deposit consisted of black, tar-contaminated fines and granular sediments. The general trends in the properties of these sediments are as follows.

4.4.1 - Physical Characteristics

(i) South Pond

- Usually consisted of very loose medium sand size particles, with some coarse sands and fine gravel size coal and coke fragments.

- Where the deposit was thicker the grain size decreased to silty fine sands.

- Some layering was evident but contacts between individual layers tended to be gradational.

- Sediments had a higher tar content than those in down-stream areas and thin bands of fused sediments sometimes occurred.

(ii) Upper Half of North Pond

- Typically consisted of very loose fine sand size particles with the top layer slightly coarser in areas of faster channel current.

- At depth the deposit changed to very loose silty fine sands or very soft silt sized particles.

(iii) Lower Half of North Pond

- Consisted of very loose fine sands to very soft silt-sized particles which decreased to very soft clay-sized particles in areas where the deposit was thicker.

- Samples released a tarry odor but tended to exhibit a more oily consistency than from upstream areas.

Figure 4 is an isopach map of the PAH-contaminated sediments. The thickest area (in excess of 4 m) occurs in the basin surrounding Borehole B5 in the North Pond. Another thick area occurs in the vicinity of Borehole B66, while the contaminated sediments are thin overlying the ridge of till near Borehole B10. The thick area surrounding Boreholes B8 and B9 downstream of the Ferry Street bridge corresponds to the prominent bar at this location. In the South Pond, the greatest accumulation of contaminated sediment is within the basin centered near Borehole B57.

Based on the above isopach map a revised estimate was made of the total in situ volume of the contaminated deposit. In the South Pond a total volume of 225,000 m^3 was determined whereas in the North Pond a value of 325,000 m^3 was estimated. This respectively represents about 85% and 65% of the original estimate for each pond. This results in a total volume of 550,000 m^3 for the entire Tar Ponds, or about 70% of the original estimate.

These estimates cover the confines of the Tar Ponds estuary from the mouths of Coke Oven and Wash Brook (at Prince Street) to the mouth of the Tar Ponds at Battery Point. It does not include any

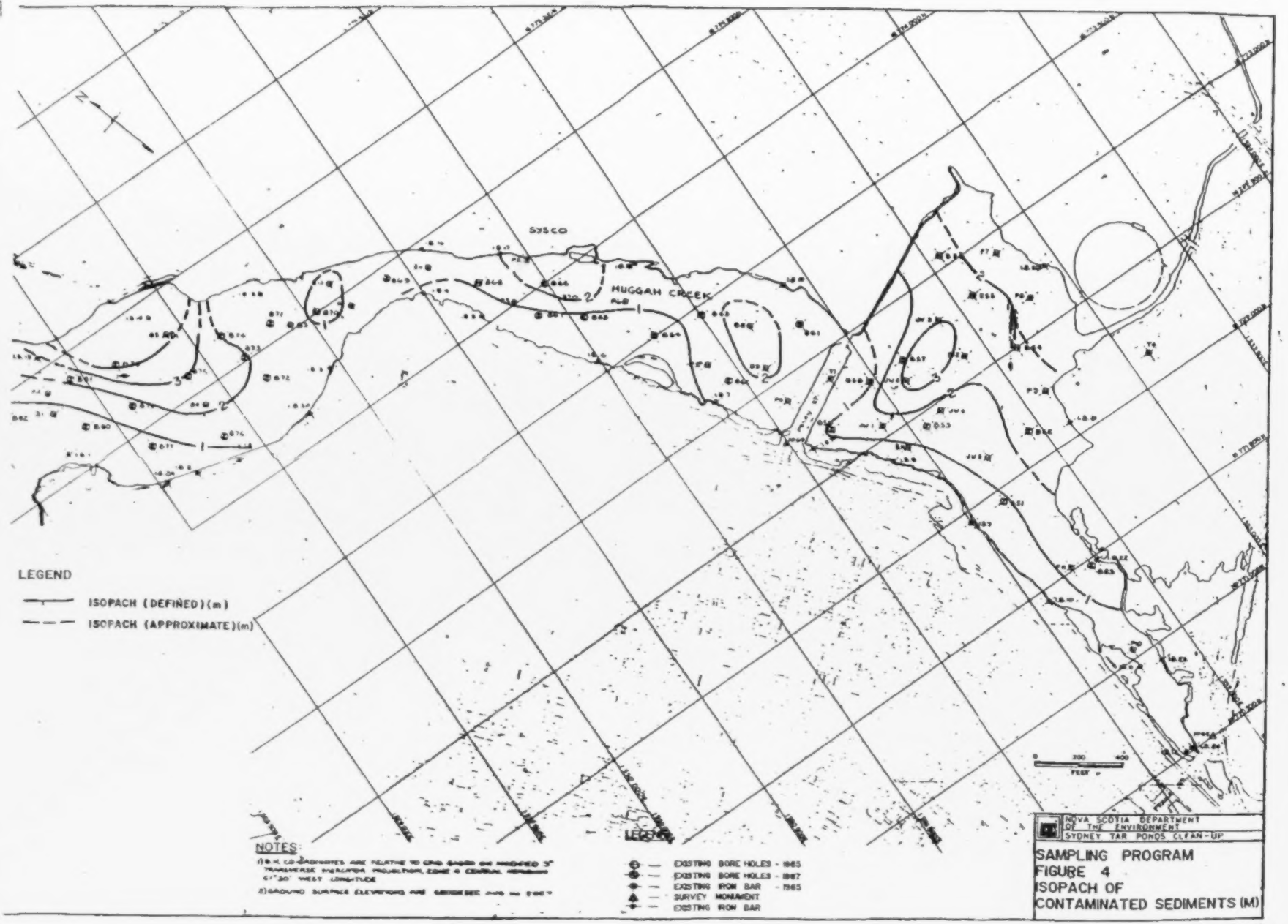
SYSCO
HUGGAH CREEK
LEGEND
ISOPACH (DEFINED)(m)
ISOPACH (APPROXIMATE)(m)
NOTES:
LEGEND
EXISTING BORE HOLES - 1985
EXISTING BORE HOLES - 1987
EXISTING IRON BAR - 1985
SURVEY MONUMENT
EXISTING IRON BAR
NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT
SYDNEY TAR PONDS CLEAN-UP
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FIGURE 4
ISOPACH OF
CONTAMINATED SEDIMENTS (M)

contaminated material which may be present within the banks of the estuary.

Depending on the method of containment and excavation during the construction phase of the cleanup the excavated quantity will also inevitably include some overcut and local deeper zones. It is anticipated that this would result in excavation, even for a well controlled operation of another 0.15 m average leading to in excess of 600,000 m^3 of in situ volume to be removed.

4.4.2 - Chemical and Thermal Characteristics

Data are available from both the Acres (1985) Sydney Tar Pond Study and from this 1987 investigation. During 1985, both surface and borehole sampling was carried out while in 1987 all samples were obtained from boreholes. In both cases, the borehole samples were generally collected over 0.6 m intervals. PAH analyses were later carried out using GC/MS for both data sets but using different laboratories. A more extensive suite of PAHs was quantified in 1987.

It was decided that with the relatively comprehensive set of borehole data now available that this would be sufficient to define the PAH and thermal properties of the contaminated deposit. Consequently, the 1985 surface data was not incorporated in this summary. For PAHs, the 1985 and 1987 data sets were compared both in terms of the average concentration over the deposits and the relative concentrations of the various individual compounds.

Comprehensive data on the heavy metal concentrations and HNC concentration is only available from the 1987 data.

(a) PAHs

In order to obtain total PAH, all data were adjusted to a common base corresponding to the 1987 set of PAH compounds. For the 1985 data set this was carried out by multiplying the sum of 1985 compounds by a factor derived from the 1987 data. Following review of the reduced data set, sample 3 from Borehole B7 was anomalously high (34,000 mg/kg) compared to other data and particularly to the sample immediately above. As no physical reason was apparent for this discrepancy (apart from a possible local hot spot), this data point was deleted from the analysis.

The reduced data used for PAH analyses is shown in Table 4.1. The top portion of this table is the 1987 data set, sorted by depth below ground surface and distance downstream of Coke Oven Brook. The sorted 1985 data is presented in the lower part of the same table. Note that for the 1985 data, chrysene and triphenylene were combined and are listed as chrysene in the table for 1985.

Upon scanning the data the only differences that seem inconsistent between the data sets are the following compounds.

	1985	1987
Benzo(k)fluoranthene	4.5%	0.9%
Benzo(e)pyrene	2.1%	0.4%
Phenanthrene	10.0%	26.0%

TABLE 4.1

PAH DISTRIBUTION BY COMPOUND

Data Set	Avg Pak by depth (ug/Kg)	Dist downstrm (m)	Sample ID BH#	Depth	naphthalene																		Total Pah (ug/Kg)
						fluoranthene					ind[1,2,3-cd]pyrene	acenaphthylene		benzo[a]pyrene		acenaphthene		benzo[a]anthracene				
							benzo[b]fluoranthene			dibz[a,h]anthracene	benzo[k]fluoranthene	anthracene	chrysene	benzo[e]pyrene	pyrene	phenanthrene	triphenylene	benzo[ghi]perylene	fluorene				
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
		88	54	1	6.92%	7.95%	6.67%	3.05%	0.98%	5.60%	0.41%	1.67%	3.39%	7.07%	2.47%	5.50%	2.26%	21.26%	0.00%	10.84%	8.08%	1.11%	3787
		245	57	1	59.95%	4.25%	2.50%	0.68%	0.00%	0.11%	4.76%	5.26%	0.92%	1.61%	0.00%	4.72%	0.32%	6.41%	0.00%	3.91%	0.03%	3.78%	22757
		250	56	1	9.22%	6.84%	3.05%	0.81%	0.55%	2.54%	0.41%	3.02%	2.25%	2.60%	2.04%	6.01%	3.97%	47.00%	0.00%	6.56%	0.00%	3.12%	2788
		265	51	1	26.81%	3.66%	1.49%	0.67%	0.28%	1.25%	1.90%	2.38%	1.17%	1.86%	0.52%	4.44%	0.48%	41.30%	0.00%	7.39%	1.16%	3.25%	10560
		365	83	1	13.31%	6.35%	3.12%	0.81%	0.46%	2.61%	1.35%	2.62%	2.28%	3.46%	1.15%	6.35%	1.47%	44.33%	0.00%	6.72%	0.47%	3.19%	3745
		365	59	1	60.33%	2.07%	0.48%	0.08%	0.04%	0.40%	1.12%	1.34%	0.65%	1.21%	0.29%	1.92%	1.37%	22.91%	0.00%	3.63%	0.14%	2.87%	18436
		535	63	1	45.71%	6.31%	0.94%	0.32%	0.13%	0.12%	2.04%	5.71%	0.91%	1.88%	-0.02%	6.19%	0.40%	7.56%	15.64%	5.15%	0.11%	0.54%	5185
		760	66	1	47.58%	3.02%	1.85%	0.95%	0.32%	1.55%	0.93%	1.40%	1.21%	2.28%	0.64%	3.60%	0.23%	25.65%	0.00%	4.87%	2.51%	1.40%	11738
		760	67	1	48.78%	2.79%	1.06%	0.48%	0.25%	1.47%	0.55%	1.95%	1.00%	1.00%	0.59%	2.65%	1.20%	30.57%	0.00%	2.94%	0.14%	2.52%	5435
		985	69	1	10.71%	5.30%	2.41%	0.69%	0.31%	2.03%	2.52%	3.02%	2.07%	2.43%	0.63%	6.87%	0.52%	47.61%	0.00%	7.99%	1.69%	3.20%	10111
		985	69	1	12.87%	5.47%	2.74%	0.87%	0.33%	2.29%	2.58%	2.48%	2.03%	2.99%	0.84%	7.30%	0.34%	44.01%	0.00%	8.01%	2.24%	2.61%	8468
		985	69	1	11.96%	4.58%	2.04%	1.48%	0.27%	1.17%	2.06%	2.32%	1.94%	3.63%	0.94%	9.25%	0.32%	45.81%	0.00%	10.41%	1.64%	2.57%	10325
		1100	70	1	35.02%	3.60%	2.26%	0.66%	0.19%	1.90%	0.63%	1.85%	1.55%	2.52%	0.67%	4.43%	0.23%	30.93%	0.00%	6.73%	1.18%	1.66%	12892
		1220	72	1	36.41%	4.35%	1.31%	1.00%	0.24%	1.09%	0.62%	1.98%	1.54%	3.01%	0.85%	4.95%	0.29%	34.83%	0.00%	7.09%	0.59%	1.02%	6764
		1240	74	1	28.33%	10.15%	4.51%	1.20%	0.39%	0.36%	2.23%	9.80%	1.51%	3.23%	-0.05%	9.70%	0.77%	12.15%	-0.05%	8.17%	1.20%	6.40%	1970
	9011.4	1400	77	1	37.37%	5.11%	0.15%	0.00%	0.00%	0.00%	0.25%	2.06%	0.96%	0.28%	0.14%	6.31%	0.54%	40.02%	0.00%	5.34%	0.00%	1.47%	3822
		245	53	2	53.59%	1.77%	0.70%	0.23%	0.09%	0.59%	0.89%	1.52%	0.55%	1.18%	0.24%	5.55%	2.16%	27.74%	0.00%	2.91%	0.28%	3.34%	17750
		245	57	2	35.11%	2.80%	1.91%	0.64%	0.22%	1.60%	3.88%	2.10%	0.92%	2.09%	0.50%	3.80%	0.19%	33.95%	0.00%	6.33%	1.12%	3.11%	17354
1		305	61	2	15.75%	4.56%	1.54%	0.48%	0.50%	1.34%	3.27%	3.17%	1.48%	1.62%	0.94%	4.56%	1.80%	48.34%	0.00%	5.11%	0.29%	5.21%	3773
9		1100	70	2	21.90%	9.69%	3.13%	0.86%	0.08%	0.08%	3.50%	10.54%	1.28%	2.04%	-0.03%	8.11%	1.07%	12.82%	10.87%	8.04%	0.06%	6.36%	2972
8		1100	70	2	30.89%	9.11%	1.07%	0.99%	0.31%	0.21%	2.81%	13.53%	1.38%	2.24%	-0.04%	8.79%	0.97%	13.63%	-0.04%	7.12%	0.32%	6.79%	2765
7		1300	75	2	57.14%	3.14%	1.62%	0.65%	0.21%	0.68%	0.59%	1.25%	1.23%	1.86%	0.59%	5.67%	0.26%	19.56%	0.00%	5.04%	1.59%	0.93%	11020
		1320	76	2	54.89%	1.22%	3.55%	1.12%	0.06%	0.13%	0.26%	3.92%	0.81%	2.59%	-0.05%	6.16%	0.91%	6.06%	0.00%	7.71%	1.56%	2.60%	1996
	8204.5	1390	79	2	50.65%	1.55%	1.20%	0.86%	0.00%	0.00%	0.49%	1.55%	1.00%	3.24%	0.93%	5.75%	0.68%	21.57%	0.00%	8.04%	0.00%	1.70%	8006
		88	54	3	16.22%	13.84%	8.07%	2.71%	0.23%	0.23%	0.59%	5.30%	1.98%	5.05%	-0.00%	13.99%	3.85%	9.30%	3.87%	11.61%	0.16%	3.95%	1301
		150	52	3	22.39%	7.42%	2.51%	0.48%	0.10%	0.27%	3.50%	10.81%	1.04%	1.85%	-0.02%	6.34%	3.05%	12.36%	13.55%	5.56%	0.03%	9.01%	4257
		760	66	3	26.88%	5.23%	1.09%	0.10%	0.00%	0.03%	2.55%	6.75%	0.57%	1.25%	-0.11%	3.94%	1.64%	1.06%	33.37%	3.15%	0.00%	5.68%	878
	2334.8	1390	79	3	67.19%	5.99%	1.49%	0.21%	0.00%	0.07%	0.62%	4.55%	0.56%	0.97%	-0.03%	5.24%	0.89%	6.44%	0.00%	3.22%	0.32%	2.27%	2904
		175	55	4	80.81%	2.31%	1.04%	0.30%	0.01%	0.05%	1.10%	2.70%	0.49%	0.67%	0.00%	2.46%	0.50%	3.34%	0.37%	1.87%	0.03%	2.05%	21062
		300	58	4	16.43%	5.21%	3.23%	0.42%	0.63%	1.10%	3.29%	2.56%	2.68%	1.53%	0.83%	4.41%	1.76%	43.45%	0.00%	6.67%	0.41%	5.39%	2653
		535	63	4	17.77%	7.98%	2.18%	0.47%	0.03%	0.11%	0.54%	12.96%	1.03%	1.48%	-0.04%	7.14%	6.30%	16.51%	0.87%	5.50%	0.15%	10.95%	2492
		760	66	4	18.45%	4.28%	0.23%	0.00%	0.00%	0.00%	1.49%	3.75%	1.28%	1.15%	0.31%	9.51%	2.03%	49.36%	0.00%	5.86%	0.00%	4.95%	1447
	6060.8	1300	75	4	25.53%	4.38%	1.00%	0.30%	0.29%	1.35%	0.63%	2.88%	1.45%	1.69%	1.02%	3.57%	1.46%	45.76%	0.00%	5.21%	0.00%	3.54%	2650
		300	58	5	17.33%	2.58%	0.12%	0.00%	0.00%	0.10%	2.93%	3.74%	1.49%	0.68%	0.17%	0.67%	2.66%	52.38%	0.00%	6.63%	0.00%	4.91%	2011
	1401.9	1390	79	5	26.23%	13.37%	5.18%	0.68%	0.00%	0.24%	1.31%	8.16%	1.46%	3.11%	-0.13%	11.16%	1.77%	12.57%	0.00%	8.35%	1.41%	4.53%	793
		Average			33.5%	5.3%	2.0%	0.6%	0.2%	0.9%	2.4%	4.4%	1.5%	2.1%	0.4%	5.4%	1.1%	26.3%	2.2%	6.6%	0.8%	3.6%	average	7209
		Std Dev			18.9%	3.0%	1.0%	0.7%	0.2%	1.1%	6.5%	4.0%	1.0%	1.0%	0.6%	2.7%	1.6%	16.2%	6.3%	4.2%	1.5%	2.2%	Std Dev	6524
		280	11	1		5.82%	3.01%	1.84%		5.01%	4.62%	3.98%	3.79%	3.84%	1.87%	4.52%	0.75%	8.73%		4.78%	1.53%	4.74%		16400
1	9248.0	1500	1	1		8.92%	4.10%	2.67%		6.19%	1.14%	6.06%	3.15%	4.34%	2.39%	7.25%	0.00%	9.54%		3.39%	2.34%	1.56%		2096
9		110	7	2		9.15%	4.96%	1.72%		4.96%	0.78%	2.23%	6.09%	3.34%	2.11%	6.55%	0.25%	7.36%		6.32%	1.25%	2.00%		8163
8		1140	3	3		7.79%	2.15%	1.23%		3.48%	0.92%	5.63%	2.66%	2.99%	1.33%	5.23%	3.18%	13.11%		3.38%	0.82%	4.82%		976
5	4451.9	1300	4	4		8.65%	3.98%	2.36%		3.98%	1.03%	4.22%	3.66%	4.20%	2.15%	6.16%	0.56%	9.30%		4.07%	2.04%	2.11%		4452
		Average				8.1%	3.6%	2.0%		4.3%	1.7%	4.0%	3.8%	3.7%	2.1%	6.1%	0.9%	9.6%		4.4%	1.6%	3.1%	average	6417
																							Std Dev	5565

The average PAH concentrations are as follows.

	Average	Std. Dev.	No. of Samples
1985	6,417	5,565	5
1987	7,208	6,524	35

Based on the above data, total PAHs are not significantly different between the two sets and combination into one set was therefore deemed appropriate.

After combining the data into a single data set and averaging duplicate and triplicate samples, the data were sorted according to depth and distance from the mouth of Coke Oven Brook. Various data combinations were then reviewed.

Table 4.2 is one such combination which sorts all data covering the top 0.6 m in depth by location. The four locations are indicated on the table. The average PAH concentrations of this layer show a general decline moving downstream. This parallels the overall decrease in grain size in the downstream direction. However, considerable fluctuation occurs in any given area. The average total PAHs, by location, are summarized below.

Area	Average total PAH (mg/kg)
Wash Brook Arm	3,700
Remainder of South Pond	12,000
North Pond to Narrows	8,000
North Pond beyond Narrows	5,500

TABLE 4.2

PAH DISTRIBUTION BY COMPOUND

Section	Avg Pah by section (ug/Kg)	Dist downstrm (m)	Sample ID BBB	Depth	naphthalene	fluoranthene	benzo[b]fluoranthene	ind[1,2,3-cd]pyrene	dibs[a,h]anthracene	bso[k]fluoranthene	acenaphthylene	anthracene	chrysene	benzo[a]pyrene	benzo[e]pyrene	pyrene	acenaphthene	phenanthrene	triphenylene	benzo[a]anthracene	benzo[ghi]perylene	fluorene	Total Pah (ug/Kg)
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Wash Brook Arm	3745	365	83	1	13.31%	6.36%	3.12%	0.81%	0.46%	2.61%	1.33%	2.62%	2.26%	2.46%	1.19%	6.36%	1.47%	44.33%	0.00%	6.72%	0.47%	3.19%	3745
		88	56	1	6.92%	7.95%	6.67%	3.46%	0.98%	6.60%	0.41%	1.67%	3.39%	7.07%	2.47%	9.50%	2.26%	21.24%	0.00%	10.84%	0.88%	1.11%	3787
		245	57	1	59.95%	4.26%	2.50%	0.68%	0.00%	0.11%	4.76%	5.26%	0.92%	1.61%	0.00%	4.72%	0.32%	6.41%	0.00%	3.91%	0.03%	3.78%	27157
South Pond		350	56	1	9.22%	6.84%	3.05%	0.81%	0.55%	2.54%	0.41%	5.02%	2.25%	2.60%	2.04%	6.01%	2.97%	47.00%	0.00%	6.56%	0.00%	3.12%	2788
		265	51	1	26.01%	3.46%	1.49%	0.67%	0.28%	1.25%	1.90%	2.38%	1.17%	1.85%	0.52%	4.44%	0.48%	41.30%	0.00%	9.39%	1.16%	3.25%	10969
		260	11	1		5.82%	3.01%	1.84%		5.01%	4.62%	3.98%	3.79%	3.84%	1.87%	4.52%	0.95%	8.73%		4.78%	1.53%	6.74%	16400
	11982	365	59	1	60.33%	2.07%	0.48%	0.08%	0.04%	0.40%	1.12%	1.34%	0.69%	1.21%	0.29%	1.92%	1.37%	22.01%	0.00%	3.63%	0.14%	2.87%	18436
		535	63	1	45.71%	6.31%	0.94%	0.72%	0.13%	0.12%	2.04%	5.71%	0.91%	1.88%	-0.02%	6.19%	0.40%	7.56%	15.64%	5.15%	0.11%	0.50%	5185
Upper half		760	67	1	48.78%	2.79%	1.06%	0.48%	0.25%	1.47%	0.59%	1.95%	1.00%	1.00%	0.59%	2.65%	1.20%	30.57%	0.00%	2.94%	0.14%	2.52%	5435
North Pond		760	66	1	47.58%	3.03%	1.85%	0.95%	0.32%	1.55%	0.93%	1.40%	1.21%	2.28%	0.64%	3.60%	0.23%	25.65%	0.00%	4.87%	2.51%	1.40%	11738
	7998	985	69	1	11.84%	5.25%	2.40%	1.01%	0.30%	1.83%	2.35%	2.61%	2.01%	3.02%	0.81%	7.14%	0.35%	45.54%	0.00%	8.80%	1.05%	2.80%	9635
		1100	70	1	39.02%	3.60%	2.26%	0.66%	0.19%	1.90%	0.63%	1.85%	1.55%	2.52%	0.67%	4.43%	0.23%	30.93%	0.00%	6.73%	1.18%	1.66%	12892
Lower half		1220	72	1	34.41%	4.35%	1.31%	1.00%	0.14%	1.09%	0.62%	1.98%	1.54%	3.01%	0.89%	4.95%	0.29%	34.83%	0.00%	7.09%	0.59%	1.82%	6764
North Pond		1240	74	1	28.33%	10.15%	4.51%	1.20%	0.39%	0.36%	2.23%	9.80%	1.51%	3.23%	-0.05%	9.70%	0.77%	12.13%	-0.05%	8.17%	1.20%	6.40%	1970
		1400	77	1	37.37%	5.11%	0.15%	0.00%	0.00%	0.00%	0.25%	2.06%	0.96%	0.28%	0.14%	6.31%	0.54%	40.02%	0.00%	5.34%	0.00%	1.47%	3822
	5509	1560	1	1		8.92%	4.10%	2.67%		4.10%	1.14%	4.06%	3.15%	4.34%	2.39%	7.25%	0.00%	9.54%		3.39%	2.34%	1.96%	2096

Reviewing trends with depth, the data (as summarized below) show little variation over the top two depth intervals and with a noticeable reduction below 1.2 m. Even taking into account the fact that some of the samples have a small portion of the underlying clean materials incorporated in with the tar pond deposit, total PAH generally declines with depth.

Depth	Average total PAH mg/kg
0 - 0.61	9,000
0.61 - 1.22	8,200
1.22 - 1.83	2,300
1.83 - 2.44	6,100*
2.44 - 3.05	1,400

*one sample anomalously high

The general order of PAHs in terms of their relative abundance is as follows.

1 - naphthalene
2 - phenanthrene
3 - benzo(a)anthracene
4 - pyrene
5 - fluoranthene
6 - anthracene

Naphthalene and phenanthrene account for about 60 to 80% of the total PAH content. These two compounds are also the two most variable as indicated by the standard deviation data presented in Table 4.1.

(b) HNCs

The concentration of total HNCs as shown in Tables 4.3 is less variable than total PAHs with no clearly discernable trend except to note that HNCs generally correlate with PAHs.

The general order of HNCs in terms of their relative abundance is as follows.

1 - benzacridines
2 - benzocarbazole
3 - acridine
4 - 7, 8 benzoquinoline
5 - methylated benzoacridines
6 - methylated benzocarbazoles

The first three HNC compounds comprise 60 - 70% of the total HNC content.

(c) Heavy Metals

A review of Table 4.3 shows that the most distinctive trend for heavy metal concentrations is for zinc, lead and, to a lesser extent, copper to increase in concentration near the mouth of Muggah Creek. This suggests an association with the finer-grained sediments (silts and clays), which in turn may reflect adsorption due to charge and increased surface area with smaller sized sediment particles. The concentrations of arsenic and chromium are lower and more variable over the Tar Ponds.

Zinc is generally the most abundant heavy metal followed by lead, copper or arsenic, and then chromium.

TABLE 4.3

SAMPLE RESULTS -
CHEMICAL AND THERMAL PROPERTIES

Borehole	Acres Geotech. Sample No.	Depth Interval (m)	Distance Downstream Coke Oven Brook (m)	Metals As (mg/kg)	Cr	Cu	Pb	Zn	Sum of Selected BEC's[1] (mg/kg)	Calorific Content (BTU/lb)
B77	-1	0.00 - 0.61	1,400	101	61	242	441	623		
B74	-1	"	1,240	115	21	138	409	947	56.2	9,900
B72	-1	"	1,220	68	24	147	345	820		9,790
B3	-1	0.00 - 0.91	1,140	26	<40	45	230	180	-	-
B70	-1	0.00 - 0.61	1,100	45	13	47.7	154	234		
B69	-1	"	985	(69	16	103	137	233		10,500
				(69	17	52.7	153	24		9,850
				(66	15	59.9	141	207		
B6	-1	"	925	-	-	-	-	-	-	12,400
P3	-1	0.00 - 0.91	600	-	-	-	-	-	-	10,500
B67	-1	0.00 - 0.61	760	87	8	35.1	145	222		
B66	-1	"	760	53	40	75	194	292		11,100
B63	-1	"	535	48	21	91.6	278	534	41.4	9,930
B83	-1	"	365	211	31	89	319	370		
B59	-1	"	365	172	10	65.7	181	237		
B11	-1	"	280	-	-	-	-	-	-	8,700
B51	-1	"	265	92	13	110	436	660		8,930
B56	-1	"	250	156	27	171	598	640		
B57	-1	"	245	<.01	61	34.8	88	132	1,510	9,280
B54	-1	"	88	37	15	94.8	170	288		12,600
B79	-2	0.61 - 1.22	1,380	70	55	136	267	514		9,080
B76	-2	"	1,320	67	34	181	427	1,230	24.8	3,040
B5	-2	0.76 - 1.37	1,310	-	-	-	-	-	-	7,000
B70	-2	0.61 - 1.22	1,100	(17	13	40.4	164	255	201	5,360
				(53	14	38	137	267	33.4	4,260
P2	-2	"	790	-	-	-	-	-	-	1,300

Table 4.3
Sample Results -
Chemical and Thermal Properties - 2

Borehole	Acres Geotech. Sample No.	Depth Interval (m)	Distance Downstream Coke Oven Brook (m)	Metals As (mg/kg)	Cr	Cu	Pb	Zn	Selected BNC's[1] (mg/kg)	Calorific Content (BTU/lb)
B61	-2	"	395	95	5	25.6	73	212		8,930
B53	-2	"	245	99	6	34.7	105	151		12,700
B57	-2	"	245	99	7	35.9	123	154		11,300
P12	-2	0.76 - 1.37	160	110	<40	45	210	300	-	-
B79	-3	1.22 - 1.83	1,390	38	54	162	317	595	32.4	8,510
B5	-3 to 6	1.37 - 4.11	1,310	-	-	-	-	-	-	8,200
B75	-2	1.22 - 1.83	1,300	38	47	120	275	518		
B66	-3	"	760	210	11	44.4	216	159	26.7	11,600
B7	-3	1.22 - 1.52	710	-	-	-	-	-	-	11,900
B9	-3	1.22 - 1.83	450	-	-	-	-	-	-	13,700
B52	-3	"	150	61	9.7	46.4	161	198	42.2	10,200
B54	-3	"	88	11	12	70.8	91	175	67.4	12,300
B4	-4	1.83 - 2.44	1,300	-	-	-	-	-	-	8,500
B66	-4	"	760	165	9	47.7	174	173		
B63	-4	"	535	98	15	104	222	310	65.6	8,500
B8	-4	"	460	-	-	-	-	-	-	12,400
B58	-4	"	300	51	11	42.1	113	162		
B55	-4	"	175	33	42	82.8	424	541	76.8	11,300
B79	-5	2.44 - 3.05	1,390	56	123	185	404	1,200	14	6,870
B75	-4	"	1,300	114	14	112	507	823		

Table 4.3
Sample Results -
Chemical and Thermal Properties - 3

[1]Selected HNCs

methylated benzocarbazoles
methylated benzoacridines
2,4 dimethylquinoline
carbazole
acridine
quinoline
benzacridines
benzocarbazole
7,8 benzoquinoline
dimethylquinoline

Note

Sample Nos. for 1985 Boreholes (B1 to B11 and P series) have been revised according to the numbering scheme outlined in Appendix A.

(d) Calorific Content

Despite the variability previously noted in the chemical parameters, the calorific content of the contaminated sediment is relatively uniform (see Table 4.3). The calorific content on a dry weight basis tends to decrease slightly towards the mouth of Muggah Creek following the overall grain size decrease in this direction. Apart from Borehole B79 there is no significant change in concentration with depth at a given site. About 9,000 BTU/lb (dry weight) could be considered as an overall average value for the Tar Ponds. As would be expected ash content increases with decreasing calorific content.

4.4.3 - PAH Analysis of Deposits Underlying Tar Ponds

To determine the extent of contaminant drop-off in the deposits underlying the coke/coal materials, three samples from below the visibly contaminated material were selected for PAH analyses. These samples were chosen according to the following criteria.

- provide representative coverage of different areas of the Tar Ponds
- samples of the underlying deposit available as a core and representing a depth interval close to the interface with the overlying contaminated materials
- PAH analysis of the overlying contaminated materials to have previously been carried out

Based on the above criteria, samples from Boreholes B58, B66 and B76 were selected starting approximately 5 cm below the identified interface. The underlying deposit at the first two

borehole locations consists of clayey silt while till underlies the contaminated materials at Borehole B76. Following receipt of the results closer examination of the sample from Borehole B58 indicated it was contaminated with the tar pond material.

The results for Boreholes B66 and B76 are presented in Table 4.4. As can be seen the total PAH of the underlying deposit is at least three orders of magnitude lower in concentration than the corresponding concentrations in the overlying coke/coal materials. The underlying materials are therefore considered to be uncontaminated and the visual demarcation between the coal tar deposit and the underlying material corresponds well to the boundary of chemical contamination.

TABLE 4.4

TOTAL PAH OF SELECTED SAMPLES AT
BASE OF AND BELOW TAR POND MATERIALS

Borehole No.	Sample No.	Distance Downstream Coke Oven Brook (m)	Depth Interval Analyzed (m)	Deposit Type	Total PAH (mg/kg)
B66	AQ-4	760	1.83 - 2.36	BCM	1,450
	AS-5		2.45 - 2.90	CS	0.62
			2.64 - 2.90	CS	2.9/2.2/1.0
B76	AQ-2	1,320	0.61 - 1.14	BCM	2,000
	AS-3		1.40 - 1.55	GS	0.59

BCM - Black coke/coal materials
CS - Clayey silt
GS - Gravelly silt (till)

REFERENCES

Acres International Limited, June 1985 "Sydney Tar Pond Study, Final Project Report, Vols. I, II and III. Nova Scotia Department of the Environment.

Jacques, Whitford and Associates Limited, 1981 "Soil Conditions Muggah Creek". C.A. Campbell Engineering Limited.

APPENDIX A

DRILLING REPORTS

Nova Scotia Department of the Environment
Sydney Tar Ponds Clean Up
Muggah Creek 1987 Drilling Investigation

Explanation of the
Drilling Report Forms

Location	All borehole locations shown on the Borehole Plan are relative to a grid based on a modified 3° Transverse Mercator Projection, Zone 4 central meridian, 60° 30' west longitude.
Datum	All elevations are referred to the Canadian Geodetic Datum, and are expressed in meters.
Depth	All depths are given in meters below ground surface.
Water Levels	Due to tidal fluctuations, water levels were only measured as a check on the depth from the drilling platform to ground surface. As the values have no other significance they are not reported.
Sample Type	Indicated by two letters, the first one describing the sample method and the second one the shipping container.
Sample Numbering	The order of the numbering scheme for all samples is such that increasing numbers correspond to samples taken at increasing depth. Supplementary samples of the contaminated material collected adjacent to the boreholes are identified by the suffixes A and B depending on whether one or two additional samples were collected from a given horizon.
Sample Returned	Length in centimeters of sample core returned in sampler. A value of zero indicates no return whereas the symbol NR indicates return was not recorded.

Penetration Test	Wherever the strength of the soil was measured by the Standard Penetration Test, the value given is the number of blows of a 64 kg (140 lb) hammer falling freely over 760 mm (30 in.) required to advance a split tube sampler to the depth indicated. The symbol P indicates a split tube was pushed in whereas the symbol NR indicates the value was not recorded. A value of 0 indicates split tube settled under own weight to the depth indicated.
Depth of run	Distance in meters over which the core barrel was advanced.
Core recovery	Percentage of the depth of run recovered as a core.
RQD	Rock Quality Designation is the percentage of the total length of those pieces of core longer than 100 mm (4 in.) to the depth of run (mechanical breaks included).

Drilling Report

AGRES

JOB P8186.00
HOLE B51
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 07:00 Sept. 20, 1987
FINISHED 10:00 Sept. 20, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 2.44 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.6 m
GROUND SURFACE 0.21 m
ROCK SURFACE N/a
BOTTOM OF HOLE -2.84 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, some fine gravel size fragments, very loose	AQ	1	51	0.00 - 0.61	36	P
0.9	Clayey silt	Dark brown clayey silt (organic), some fine sand, occasional wood fragments, very soft, medium plasticity, spongy	AQ	2	51	0.61 - 1.22	36	P
			AS	3	51	1.22 - 1.83	51	P
2.0	Silty sand	Dark brown silty fine sand, some fine gravel, very loose	AS	4	51	1.83 - 2.44	53	2/31 cm 8 17

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
X – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY J. A. MacLeod
APPROVED
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B51
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
2.2	Gravelly silt	Light reddish and grayish brown mottled gravelly silt, some fine sand, trace clay, dense, medium plasticity (till)	AS	5	51	2.44 - 3.05	43	28 25 21 22
3.05		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B51
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type‡	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A‡	51	0.61 - 1.22	46

‡ portion of sample contains underlying clayey silt (organic).

AGRES

Drilling Report

JOB P8186.00
HOLE B52
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 14:00 Sept. 24, 1987
FINISHED 15:15 Sept. 29, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM N/a
GROUND SURFACE 0.43 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.15 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, very loose becoming tarry with depth	A	1	51	0.00 - 0.61	0	P
			AQ	2	51	0.61 - 1.22	53	1 1 1 1
			AQ	3	51	1.22 - 1.83	53	1 1 2 2
			AQ	4	51	1.83 - 2.44	53	P

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY J. A. MacLeod
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B52
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	53	P
2.5	Silty clay	Dark brownish red silty clay (organic), some fine sand, very soft, medium plasticity, spongy						
			AQ	6	51	3.05 - 3.58	51	2 4 20 50/53 cm
3.4	Sandy silt	Dark reddish and grayish brown mottled sandy silt, some gravel, trace clay, dense to very dense (till)						
3.58		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B52
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	NR
AQ	2A	51	0.61 - 1.22	NR

2 - Description of contaminated sediment (page 1) based partially on information provided by above additional samples.

AGRES

Drilling Report

JOB P8186.00
HOLE B53
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 07:45 Sept. 21, 1987
FINISHED 08:30 Sept. 21, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 2.44 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 1.1 m
GROUND SURFACE 0.37 m
ROCK SURFACE N/a
BOTTOM OF HOLE -2.68 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, very loose to loose, tarry	AQ	1	51	0.00 - 0.61	53	2/31 cm 2 2
			AQ	2	51	0.61 - 1.22	46	5 3 2 2
1.3	Silty sand	Light reddish brown silty sand, some fine gravel, very loose	AQ	3	51	1.22 - 1.83	36	1/31 cm 1 6
1.9	Sandy silt	Light reddish brown sandy silt, some fine gravel, dense, low plasticity (till)	AS	4	51	1.83 - 2.44	36	9 19 17 12

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod

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APPROVED

DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B53
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
	Sandy silt (cont)		AS	5	51	2.44 - 3.05	33	25 20 13
3.05		End of borehole						13

ACRES

Drilling Report

JOB P8186.00
HOLE B53
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53
AQ	3A*	51	1.22 - 1.83	53

*portion of sample contains underlying silty sand.

Drilling Report

ACRES

JOB P8186.00
HOLE B54
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 29, 1987
FINISHED 10:30 Sept. 29, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM N/a
GROUND SURFACE 0.55 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.11 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles becoming coarse sand size mixture with depth, very loose, tarry	AQ	1	51	0.00 - 0.61	53	1/46 cm 1
			AQ	2	51	0.61 - 1.22	53	2 2 2 2
			AQ	3	51	1.22 - 1.83	41	3 1 1 1
			AQ	4	51	1.83 - 2.44	53	1/46 cm 1

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY J. A. MacLeod
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B54
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	41	1/31 cm 1 1
2.5	Clayey silt	Dark brown clayey silt (organic), soft becoming firm with depth, medium plasticity, spongy	AQ	6	51	3.05 - 3.66	33	3 5 13 14
		3.4 - 3.5: Coarse gravel						
3.66		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B55
SHEET 2 OF 2

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
	Clay (cont)		AQ	6	51	3.05 - 3.66	53	12 10 5 4
3.66		End of borehole						

Drilling Report

JOB P8186.00
HOLE B56
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 16:00 Sept. 29, 1987
FINISHED 16:45 Sept. 29, 1987

METHOD OF DRILLING: SOIL By hand
ROCK N/a

CASING DIAM N/a
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM N/a
GROUND SURFACE 0.43 m
ROCK SURFACE N/a
BOTTOM OF HOLE -2.16 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium to fine sands and coke/coal particles, very loose	AQ	1	51	0.00 - 0.61	53	P
			AQ	2	51	0.61 - 1.22	53	P
			AQ	3	51	1.22 - 1.83	53	P
			AQ	4	51	1.83 - 2.59	53	P
2.59		End of borehole						

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY J. A. MacLeod
APPROVED
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B56
SHEET 2 OF 2

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	3A	51	1.22 - 1.83	53
AQ	4A	51	1.83 - 2.44	53

Drilling Report

AGRES

JOB P8186.00
HOLE B57
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 07:30 Sept. 22, 1987
FINISHED 11:30 Sept. 22, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 6.71 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 1.1 m
GROUND SURFACE 0.37 m
ROCK SURFACE N/a
BOTTOM OF HOLE -6.94 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Gravelly sand with coke/coal	Black heterogeneous mixture of gravelly fine sands and coke/coal particles, some medium sand size particles, very loose, tarry	AQ	1	51	0.00 - 0.61	51	1 1 1 1
0.6	Silty sand with coke/coal	Black heterogeneous mixture of silty fine sands and coke coal particles, very loose 0.6 - 0.7: Gravelly fine sand size mixture, tarry	AQ	2	51	0.61 - 1.22	51	1/31 cm 1/61 cm

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY J. A. MacLeod
APPROVED
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B57
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test (note 2)
			A	3	51	1.22 - 2.74	0	P
2.7	Clayey silt	Dark brown clayey silt (organic), some fine sand, occasional stems, very soft, medium plasticity, slightly spongy	AQ	4	51	3.05 - 3.66	36	P
			AS	5	51	3.66 - 4.27	53	P
			AS	6	51	4.27 - 4.88	41	P
			AS	7	51	4.88 - 5.49	46	P
			AS	8	51	5.49 - 6.10	53	P
			AS	9	51	6.10 - 6.71	53	P
			AS	10	51	6.71 - 7.31	41	25 24 36 38
6.7	Silty sand	Light reddish brown silty sand, some fine gravel, very dense (till)						
7.31		End of borehole						

ACRES

Drilling Report

JOB P8186
HOLE B57
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	25
AQ	2A	51	0.61 - 1.22	53

2 - Split tube sampler and rod dropped from 1.22 to 2.74 m under own weight. Borehole cleaned out to 3.05 m before resuming sampling.

AGRES

Drilling Report

JOB P8186.00
HOLE B58
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 21, 1987
FINISHED 12:00 Sept. 21, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 6.10 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 1.1 m
GROUND SURFACE 0.34 m
ROCK SURFACE -4.76 m
BOTTOM OF HOLE -7.28 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles with some coal tar, very soft	AQ	1	51	0.00 - 0.61	53	P
0.6	Sand with coke/coal	Black heterogeneous mixture of medium sands with coke/coal particles, very loose	AQ	2	51	0.61 - 1.22	33	0/46 cm 1
0.9	Silty sand with coke/coal	Black heterogeneous mixture of silty sands and coke/coal particles, very loose, tarry	AQ	3	51	1.22 - 1.83	53	0/46 cm 2

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
T – core box
Z – discarded

INSPECTOR J. A. MacLeod

APPROVED

LOGGED BY J. A. MacLeod

DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B58
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AS	4	51	1.83 - 2.44	53	P
2.1	Clayey silt	Dark brown clayey silt (organic), some fine sand, very soft, medium plasticity, spongy	AS	5	51	2.44 - 3.05	33	P
			AS	6	51	3.05 - 3.66	43	0/31 cm 8 12
3.3	Gravelly silt	Light reddish brown gravelly silt, some clay, trace fine sand, stiff becoming very stiff with depth, medium plasticity, sticky (till)						
		3.3 - 3.7: Dark reddish and grayish mottled gravelly silt	AS	7	51	3.66 - 4.27	46	5 6 7 8
			AS	8	51	4.27 - 4.88	20	9 8 18 38
		4.9 - 5.0: Light greenish gray coarse gravel size sandstone fragments	AS	9	51	4.88 - 5.49	33	22 10 17 32
5.1	Bedrock	Dark brownish red angular fine gravel size claystone fragment, moderately weak, fresh	D	10	48	6.10 - 7.62	0	(Note 2)
7.62		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B58
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53
AQ	3A	51	1.22 - 1.83	53

2 - Core barrel sample D 10 returned to surface with zero recovery. Description and assumption bedrock located at a depth of 5.1 m based on split tube sample AS 9.

AGRES

Drilling Report

JOB P8186.00
HOLE B59
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 17:45 Sept. 19, 1987
FINISHED 18:30 Sept. 19, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE 0.09 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.57 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, some coarse sand-size particles, several thin (1-2 cm) tarry bands, loose becoming very loose with depth	AQ	1	51	0.00 - 0.61	33	0/15 cm 3 2 2
			AQ	2	51	0.61 - 1.22	8	1/61 cm
1.4	Silt	Light grayish brown silt, some sand, occasional fine gravel size sandstone fragments, firm 1.45 - 1.5: Light green coarse gravel size sandstone fragments	AQ	3	51	1.22 - 1.83	38	0/25 cm 6 29 24

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY B. G. Bennett

APPROVED
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B59
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
1.5	Sandy silt	Light reddish brown to brown sandy silt, some fine gravel, trace clay, compact, low plasticity (till)	AS	4	51	1.83 - 2.44	41	10 12 8 8
		2.4 - 3.4: Light brown silty fine sand, loose	A	5	51	2.44 - 3.05	0	1 2 7 9
			AS	6	51	3.05 - 3.66	20	2 1 8 15
3.66		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B59
SHEET 3 OF 3

Notes:

1 - Additional contaminated sample collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	36

Drilling Report

AGRES

JOB P8186.00
HOLE B61
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 08:15 Sept. 19, 1987
FINISHED 09:30 Sept. 19, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 4.27 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.8 m
GROUND SURFACE -0.09 m
ROCK SURFACE N/a
BOTTOM OF HOLE -4.97 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, some fine sand size particles, very loose to loose, occasional thin (<1 cm) tarry bands	AQ	1	51	0.00 - 0.61	41	1 2 3 5
		0.7 - 0.9: Tarry layer	AQ	2	51	0.61 - 1.22	38	2 1 1 1
			AQ	3	51	1.22 - 1.83	53	P
1.4	Silty sand with coke/coal	Black heterogeneous mixture of silty fine sands and coke/coal particles with some coal tar, very loose	AQ	4	51	1.83 - 2.44	53	P

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B61
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	46	0/15 cm 1/61 cm
2.8	Silty sand	Dark brown silty fine sand (organic), some clay, occasional shell fragments, very soft, medium plasticity, spongy	AS	6	51	3.05 - 3.66	25	0/31 cm
			AS	7	51	3.66 - 4.27	41	0/31 cm 2/61 cm
			AS	8	51	4.27 - 4.88	53	10 29 35 44
4.3	Gravelly sand	Dark grayish to reddish brown gravelly fine sand, some silt, trace clay, very dense (till)						
4.88		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B61
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53

Drilling Report

JOB P8186.00
HOLE B62
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 06:30 Sept. 19, 1987
FINISHED 07:45 Sept. 19, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 2.44 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.9 m
GROUND SURFACE -0.06 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.11 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, some fine gravel size fragments, very loose	AQ	1	51	0.00 - 0.61	33	0/15 cm 1/61 cm
0.1	Sandy silt with coke/coal	Black heterogeneous mixture of sandy silts and coke/coal particles, very soft	A	2	51	0.61 - 1.22	0	2 1 1/61 cm (note 3)
1.3	Sandy silt	Dark brown sandy silt (organic), some clay, very soft, medium plasticity, spongy	AS	3	51	1.83 - 2.44	46	0/46 cm 9

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content jar
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

Form 318 A (1)

ACRES

Drilling Report

JOB P8186.00
HOLE B62
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	Sample No.	Sample Size (mm)	Sample Depth (m)	Sample Ret'd (cm)	Penetration Test
2.3	Gravelly sand	Dark brown to light reddish brown gravelly fine sand, some silt, occasional subangular coarse gravel, trace clay, dense (till)	AS	4	51	2.44 - 3.05	23	15 21 13 10
3.05		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B62
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	38
AQ	1B	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	23
AQ	3A*	51	1.22 - 1.83	31
AQ	3B*	51	1.22 - 1.83	43

* portion of sample contains underlying sandy silt (organic).

2 - Description of contaminated sediment (page 1) based partially on information provided by above additional samples.

3 - Casing dropped to 1.5 m under own weight. Borehole cleaned out to 1.83 m before resuming sampling.

AGRES

Drilling Report

JOB P8186.00
HOLE B63
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 07:00 Sept. 18, 1987
FINISHED 08:30 Sept. 18, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 1.0 m
GROUND SURFACE 0.09 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.57 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands and coke/coal particles, some fine gravel size fragments, very loose	AQ	1	51	0.00 - 0.61	43	0/31 cm 1/61 cm
0.1	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, very loose	AQ	2	51	0.61 - 1.22	46	0/15 cm 1 1/61 cm
			AQ	3	51	1.22 - 1.83	53	P
1.4	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles, very soft	AQ	4	51	1.83 - 2.44	53	P

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED M. Bentzen

LOGGED BY B. G. Bennett
DATE March, 1988

Form 318 A (1)

ACRES

Drilling Report

JOB P8186.00
HOLE B63
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	10	8 5 24 41
2.7	Silty sand	Light reddish brown silty fine sand, some angular to subangular coarse to fine gravel, trace clay, very dense (till)						
		2.4 - 2.5: Light grayish green sandstone fragment, strong	AS	6	51	3.05 - 3.66	20	NR
3.66		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B63
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	NR
AQ	2A	51	0.61 - 1.22	NR
AQ	3A	51	1.22 - 1.83	NR
AQ	4A	51	1.83 - 2.44	NR
AQ	5A*	51	2.44 - 3.05	NR

*Portion of sample contains underlying silty sand (till).

AGRES

Drilling Report

JOB P8186.00
HOLE B64
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 11:30 Sept. 17, 1987
FINISHED 12:00 Sept. 17, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 0.61 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.7 m
GROUND SURFACE -0.27 m
ROCK SURFACE N/a
BOTTOM OF HOLE -1.49 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	Sample No.	Sample Size (mm)	Sample Depth (m)	Sample Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles, very soft	AQ	1	51	0.00 - 0.61	53	P
0.3	Sandy silt	Dark grayish brown sandy silt (organic), some clay, occasional shell fragments, very soft	AQ	2	51	0.61 - 1.22	53	P
1.22		End of borehole						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B64
SHEET 2 OF 2

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A*	51	0.00 - 0.61	53

*Portion of sample contains underlying sandy silt (organic).

Drilling Report

JOB P8186.00
HOLE B65
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:45 Sept. 17, 1987
FINISHED 11:00 Sept. 17, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 1.22 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.7 m
GROUND SURFACE -0.24 m
ROCK SURFACE N/a
BOTTOM OF HOLE -2.07 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, very loose	AQ	1	51	0.00 - 0.61	53	P
0.9	Clayey silt	Dark grayish brown clayey silt (organic), some fine sand, occasional shell fragments, very soft, slightly spongy	AQ	2	51	0.61 - 1.22	41	1/31 cm 1/61 cm
			AQ	3	51	1.22 - 1.83	41	1 1/46 cm 1
1.83		End of borehole						

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED
LOGGED BY B. G. Bennett, J. A. MacLeod
DATE March, 1988

ACRES

Drilling Report

JOB P8186
HOLE B66
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	3	51	1.22 - 1.83	33	0/15 cm 1 1 1
1.3	Silty sand with coke/coal	Black heterogeneous mixture of silty fine sands and coke/coal particles with some coal tar, very loose						
			AQ	4	51	1.83 - 2.44	53	0/46 cm 1/61 cm
2.3	Clayey silt	Dark grayish brown clayey silt (organic), some fine sand, occasional shell fragments, very soft, medium plasticity, slightly spongy	AS	5	51	2.44 - 3.05	46	0/31 cm 1/61 cm
			AS	6	51	3.05 - 3.66	48	P
			AS	7	51	3.66 - 4.27	46	0/46 cm 1/61 cm
			AS	8	51	4.27 - 4.88	53	0/31 cm 1 1
			AS	9	51	4.88 - 5.49	43	0/15 cm 1 4 9
5.3	Gravelly sand	Dark gray to grayish green gravelly sand, compact to dense (till)	AS	10	51	5.49 - 6.10	8	14 19 15 13
6.10		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B66
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	NR
AQ	2A	51	0.61 - 1.22	NR
AQ	3A	51	1.22 - 1.83	NR

AGRES

Drilling Report

JOB P8186.00
HOLE B67
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 08:15 Sept. 17, 1987
FINISHED 09:15 Sept. 17, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 2.44 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.7 m
GROUND SURFACE -0.37 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.42 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test (cm)
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, very loose	AQ	1	51	0.00 - 0.61	38	0/15 1/61
0.8	Clayey silt	Dark grayish brown clayey silt (organic), some fine sand, occasional shell fragments, very soft, slightly spongy	AQ	2	51	0.61 - 1.22	43	1/31 0/45 2/61
1.4	Silty sand	Dark grayish brown silty fine sand, some subangular gravel, trace clay, occasional shell fragments, compact	AQ	3	51	1.22 - 1.83	51	3 8 5 8

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P818600
HOLE B67
SHEET 2 OF 2

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AS	4	51	1.83 - 2.44	53	6 13 13 19
2.1	Gravelly silt	Light reddish and grayish brown gravelly silt, some clay, trace fine sand, very stiff, medium plasticity, sticky (till)	AS	5	51	2.44 - 3.05	15	7 12 9 9
3.05		End of borehole						

Drilling Report

JOB P8186.00
HOLE B68
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 12, 1987
FINISHED 11:30 Sept. 12, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.49 m
ROCK SURFACE N/a
BOTTOM OF HOLE -4.15 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogemixture of coarse to medium sands and coke/coal particles, loose	AQ	1	51	0.00 - 0.61	53	NR
0.4	Sand	Light gray medium sand, some fine sand, very loose	A	2	51	0.61 1.22	0	NR
			AS	3	51	1.22 - 1.83	53	NR
		1.8 - 1.9: Subangular fine gravel						
			AS	4	51	1.83 - 2.44	46	NR
1.9	Clayey silt	Dark grayish brown clayey silt (organic), firm, low plasticity, slightly spongy						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
V – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

Form 318 A (1)

ACRES

Drilling Report

JOB P818600
HOLE B68
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AS	5	51	2.44 - 3.05	48	NR
2.7	Clayey silt	Light reddish brown clayey silt, some fine gravel, trace fine sand, very stiff, medium plasticity (till)	AQ	6	51	3.05 - 3.66	41	NR
3.66		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B68
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A*	51	0.61 - 1.22	53

*Portion of sample contains underlying medium sand.

2 - Description of contaminated sediment (page 1) based partially on information provided by above additional samples.

AGRES

Drilling Report

JOB P8186.00
HOLE B69
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 12, 1987
FINISHED 11:30 Sept. 12, 1987

METHOD OF DRILLING: SOIL NW wash bored
ROCK BV double tubed core barred

CASING DIAM 89 mm O.D. to 2.16 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.61 m
ROCK SURFACE N/a
BOTTOM OF HOLE -3.30 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of medium sands with coke/coal particles, some angular fine gravel size fragments, compact becoming very loose with depth	AQ	1	51	0.00 - 0.61	20	7 6 6 9
			A	2	51	0.61- 1.52	0	NR
1.5	Rock fragments	Light greenish gray sandstone fragments, strong	AS	3	51	1.52- 2.16	8	NR
			D	4	48	2.16 - 2.69	13	
2.69		End of borehole						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

Form 318 A (1)

ACRES

Drilling Report

JOB P8186.00
HOLE B69
SHEET 2 OF 2

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	51
AQ	2A	51	0.61 - 1.22	51

AGRES

Drilling Report

JOB P8186.00
HOLE B70
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 13, 1987
FINISHED 10:00 Sept. 13, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 0.61 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.55 m
ROCK SURFACE N/a
BOTTOM OF HOLE -1.77 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	Sample No.	Sample Size (mm)	Sample Depth (m)	Sample Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of coarse to medium sands and coke/coal particles with some coal tar and organic matter, occasional coarse to fine gravel size fragements, compact	AQ	1	51	0.00 - 0.61	51	NR
0.7	Silty sand	Light grayish brown silty medium sand, some coarse sand and fine gravel, loose	AQ	2	51	0.61 - 1.22	53	NR
1.22		End of borehole						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod

APPROVED

LOGGED BY B. G. Bennett, J. A. MacLeod

DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B70
SHEET 2 OF 2

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	38
AQ	2A*	51	0.61 - 1.22	53

*Portion of sample contains underlying silty sand.

Drilling Report

JOB P8186.00
HOLE B71
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 09:00 Sept. 14, 1987
FINISHED 11:00 Sept. 14, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 3.78 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.0 m
GROUND SURFACE -0.94 m
ROCK SURFACE N/a
BOTTOM OF HOLE -5.33 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, some coal tar with depth, loose	A	1	51	0.00 - 0.61	0	P
			A	2	51	0.69 - 1.30	0	3 4 4 2
1.8	Rock fragments	Light green sandstone fragments	AQ	3	51	1.30 - 1.90	43	0/31 cm 1 64
2.3	Gravelly silt	Light reddish and grayish brown mottled gravelly silt, some fine sand, trace clay, dense, medium plasticity (till)	DZ	4	48	1.90 - 3.43	13	
			AS	5	51	3.78 - 4.39	23	18 15 20 26
4.39		End of borehole						

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY J. A. MacLeod, B. G. Bennett

APPROVED M. J. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B71
SHEET 2 OF 2

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	43
AQ	1B	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53

2 - Description of contaminated sediment (page 1) based partially on information provided by above additional samples.

AGRES

Drilling Report

JOB P8186.00
HOLE B72
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 11:00 Sept. 13, 1987
FINISHED 12:30 Sept. 13, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.66 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.24 m
ROCK SURFACE N/a
BOTTOM OF HOLE -4.51 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, some silt sized particles, trace organic matter, loose	AQ	1	51	0.00 - 0.61	51	NR
			AQ	2	51	0.61 - 1.22	41	NR
		1.2 - 1.3; Tarry odor						
1.3	Sandy silt	Dark brown sandy silt (organic), some clay, occasional wood fragments with depth, soft, low plasticity, slightly spongy	AS	3	51	1.22 - 1.83	38	NR
			AS	4	51	1.83 - 2.44	41	NR

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY B. G. Bennett

APPROVED
DATE March, 1988

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ACRES

Drilling Report

JOB P818600
HOLE B72
SHEET 2 OF 2

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AS	5	51	2.44 - 3.05	46	NR
2.8	Sandy silt	Light gray sandy silt (organic), some clay, occasional organic matter and subrounded gravel, firm, medium plasticity						
			AS	6	51	3.05 - 3.66	38	NR
3.1	Gravelly silt	Light reddish brown gravelly silt, some fine sand, trace clay, very dense, medium plasticity (till)	AS	7	35	3.66 - 4.27	36	NR
4.27		End of borehole						

AGRES

Drilling Report

JOB P8186.00
HOLE B73
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 14:00 Sept. 13, 1987
FINISHED 15:30 Sept. 13, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.05 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.52 m
ROCK SURFACE N/a
BOTTOM OF HOLE -4.18 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles, occasional fine gravel size fragments, some coarse to medium sand size parcles and coal tar with depth, very loose to loose	AQ	1	51	0.00 - 0.61	25	NR
			AQ	2	51	0.61 - 1.22	46	NR
			AQ	3	51	1.22 - 1.83	53	NR
2.2	Gravelly sand	Dark grayish brown gravelly fine sand, some medium sand, very loose	AQ	4	51	1.83 - 2.44	53	NR

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED
LOGGED BY B. G. Bennett, J. A. MacLeod
DATE March, 1988

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ACRES

Drilling Report

JOB P818600
HOLE B73
SHEET 2 OF 2

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	48	NR
2.8	Sandy silt	Dark grayish brown sandy silt (organic), occasional subrounded fine gravel and wood fragments, some clay, firm, slightly spongy	AS	6	51	3.05 - 3.66	38	NR
3.66		End of borehole						

Drilling Report

JOB P8186.00
HOLE B74
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 16:00 Sept. 12, 1987
FINISHED 18:00 Sept. 12, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 4.27 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM
GROUND SURFACE -0.82 m
ROCK SURFACE N/a
BOTTOM OF HOLE -5.70 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles with some coal tar, some fine gravel size fragments, very loose	AQ	1	51	0.00 - 0.61	53	NR
1.1	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles, very soft	AQ	2	51	0.66 - 1.22	53	NR
			AQ	3	51	1.22 - 1.83	53	NR
1.9	Sand	Dark gray coarse to medium sand, very loose	AQ	4	51	1.83 - 2.44	53	NR
		2.5 - 2.6: Subrounded gravelly fine sand						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod

APPROVED

LOGGED BY B. G. Bennett, J. A. MacLeod

DATE March, 1988

ACRES

Drilling Report

JOB P818600
HOLE B74
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	5	51	2.44 - 3.05	53	NR
2.6	Silty sand	Dark gray silty fine sand (organic), trace clay and fibrous organic matter, loose, low plasticity, slightly spongy						
			AS	6	51	3.05 - 3.66	53	NR
		3.3 - 3.5 Wood fragments						
3.5	Sandy silt	Light gray sandy silt (organic), some clay, soft, medium plasticity, slightly spongy	AS	7	51	3.66 - 4.27	43	NR
3.9	Sandy silt	Light reddish and grayish brown mottled sandy silt, occasional sub-angular fine gravel, trace clay, dense, low to medium plasticity (till)	AS	8	51	4.27 - 4.88	15	NR
4.88		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B74
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53
AQ	3A	51	1.22 - 1.83	53
AQ	4A*	51	1.83 - 2.44	53

*Portion of sample contains underlying medium sand.

Drilling Report

ACRES

JOB P8186.00
HOLE B75
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 14:45 Sept. 14, 1987
FINISHED 16:15 Sept. 14, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 3.66 m
CORE DIAM N/a

LOCATION: See Borehole plan
BEARING N/a
INITIAL DIP vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.5 m
GROUND SURFACE -0.49 m
ROCK SURFACE N/a
BOTTOM OF HOLE -4.76 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles with some coal tar, very soft	AQ	1	51	0.00 - 1.22	13	P
			AQ	2	51	1.22 - 1.83	53	P
			AQ	3	51	1.83 - 2.44	53	P
			AQ	4	51	2.44 - 3.05	53	P
			AQ	5	51	3.05 - 3.66	43	3 4 7 16
3.1	Silt	Light grayish brown silt (organic), some clay, stiff						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B75
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
3.4	Clayey silt	Light reddish brown clayey silt, occassional fine gravel, stiff, medium plasticity (till)	AQ	6	51	3.66 - 4.27	41	8 6 8 6
4.27		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B75
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	3A	51	1.83 - 2.44	53
AQ	4A	51	2.44 - 3.05	53

AGRES

Drilling Report

JOB P8136.00
HOLE B76
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment

PROJECT Sydney Tar Ponds Clean Up

SITE Muggah Creek

CONTRACTOR: Logan Geotech Inc.

STARTED 12:15 Sept. 14, 1987
FINISHED 14:00 Sept. 14, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 1.83 m

CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.3 m
GROUND SURFACE -0.73 m
ROCK SURFACE -3.03 m
BOTTOM OF HOLE -3.17 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles with some coal tar, very soft	A	1	51	0.00 - 0.61	0	P
			AQ	2	51	0.61 - 1.22	53	P
			AS	3	51	1.22 - 1.83	33	11 24 11 15
1.3	Gravelly silt	Light reddish brown gravelly silt, some fine sand, trace clay, dense becoming very dense with depth, low plasticity (till)						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod

APPROVED

LOGGED BY B. G. Bennett

DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B76
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AS	4	51	1.83 - 2.44	53	14 23 39 75
2.3	Bedrock	Dark grayish green subangular coarse gravel size siltstone fragment, slightly weathered						
2.44		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B76
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	NR
AQ	1B	51	0.00 - 0.61	NR
AQ	2A	51	0.61 - 1.22	NR

2 - Description of contaminated sediment (page 1) based partially on information provided by above additional samples.

Drilling Report

ACRES

JOB P8186.00
HOLE B77
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 13:45 Sept. 15, 1987
FINISHED 15:15 Sept. 15, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 0.81 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.7 m
GROUND SURFACE -0.76 m
ROCK SURFACE -1.56 m
BOTTOM OF HOLE -2.89 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	Sample No.	Sample Size (mm)	Sample Depth (m)	Sample Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles with some coal tar, very loose	AQ	1	51	0.00 - 0.61	43	P
0.8	Bedrock	For description, see following sheet	AQ	2	51	0.61 - 0.81	20	27 50/20 cm

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED [signature]

LOGGED BY J. A. MacLeod, B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B77
SHEET 2 OF 3

Depth	Rock Type	Description	Depth of Run (m)	Core Rec'y and RQD*
0.00	Overburden	For description, see previous sheet		
0.8	Siltsone	0.81 - 1.52: Dark brownish gray, fine grained, weak, highly weathered	0.81 - 2.13	85 26*
		1.52 - 2.13: Strong, moderately spaced bedding planes, rough, fresh		
2.13		End of borehole		

ACRES

Drilling Report

JOB P8186.00
HOLE B77
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	41
AQ	1B	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 0.81	20

Drilling Report

JOB P8186.00
HOLE B78
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 13:45 Sept. 15, 1987
FINISHED 16:30 Sept. 15, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 1.83 m
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.7 m
GROUND SURFACE -0.88 m
ROCK SURFACE -3.08 m
BOTTOM OF HOLE -3.17 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles with some coal tar, becoming silt size mixture with depth, very soft	AQ	1	51	0.00 - 0.61	53	P
			AQ	2	51	0.61 - 1.22	53	P
1.4	Gravel	Dark grayish brown subangular fine gravel size sandstone fragments, slightly weathered	AQ	3	51	1.22 - 1.83	38	0/20 cm 3 32 22

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED

LOGGED BY J. A. MacLeod, B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B78
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd	Penetration Test (cm)
2.2	Bedrock	Dark greenish gray angular coarse gravel size sandstone fragments, moderately strong	AS	4	51	1.83 - 2.29	41	18 37 75/46 cm
2.29		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B78
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	53
AQ	2A	51	0.61 - 1.22	53

AGRES

Drilling Report

JOB P8186.00
HOLE B79
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment

PROJECT Sydney Tar Ponds Clean Up

SITE Muggah Creek

CONTRACTOR: Logan Geotech Inc.

STARTED 09:15 Sept. 15, 1987

FINISHED 12:30 Sept. 15, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK N/a

CASING DIAM 89 mm O.D. to 6.10 m

CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.4 m
GROUND SURFACE -0.94 m
ROCK SURFACE -7.54 m
BOTTOM OF HOLE -7.60 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles with some coal tar, very loose	A	1	51	0.00 - 0.61	0	P
		0.4 - 0.6: Silt size mixture	AQ	2	51	0.61 - 1.22	53	P
		0.8 - 0.9: Medium sand size mixture, very loose						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod

APPROVED

LOGGED BY B. G. Bennett

DATE March, 1988

ACRES

Drilling Report

JOB P8186.00
HOLE B79
SHEET 2 OF 3

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
			AQ	3	51	1.22 - 1.83	53	P
0.9	Silt with coke/coal	Black heterogeneous mixture of silts and coke/tar particles with some coal tar, becoming clay size mixture with depth, very soft	AQ	4	51	1.83 - 2.44	53	P
			AQ	5	51	2.44 - 3.05	53	P
			AQ	6	51	3.05 - 3.66	53	P
			AQ	7	51	3.66 - 4.27	53	0/38 cm 3 15
4.0	Sand	Light gray fine sand, some coarse sand, compact						
4.2	Gravelly silt	Light reddish brown gravelly silt, some fine sand, trace clay, dense becoming very dense with depth, low to medium plasticity (till)	AS	8	51	4.27 - 4.88	38	13 27 16 21
			AS	9	51	4.88 - 5.49	48	7 21 62 39
			AS	10	51	5.49 - 6.10	41	22 35 43 39
			AS	11	51	6.10 - 6.66	36	24 48 73 102/56 cm
6.6	Bedrock	Dark reddish brown angular fine gravel size claystone fragments, moderately weak						
6.66		End of borehole						

ACRES

Drilling Report

JOB P8186.00
HOLE B79
SHEET 3 OF 3

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	3A	51	1.22 - 1.83	18
AQ	4A	51	1.83 - 2.44	46
AQ	5A	51	2.44 - 3.05	53
AQ	6A	51	3.05 - 3.66	53
AQ	7A*	51	3.66 - 4.27	53

*Portion of sample contains underlying fine sand.

AGRES

Drilling Report

JOB P8186.00
HOLE B80
SHEET 1 OF 2

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 08:30 Sept. 16, 1987
FINISHED 10:15 Sept. 16, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 0.53 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.5 m
GROUND SURFACE -1.13 m
ROCK SURFACE -1.53 m
BOTTOM OF HOLE -3.26 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles with some coal tar, very soft	AQ	1	51	0.00 - 0.53	41	0/31 cm 5 39/53 cm
0.4	Bedrock	For description, see following sheet						

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED B. G. Bennett
LOGGED BY J. A. MacLeod, B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B80
SHEET 2 OF 2

Depth (m)	Rock Type	Description	Depth of Run (m)	Core Rec'y and RQD*
0.00	Overburden	For description, see previous sheet		
0.4	Claystone	0.61 - 0.80: Dark reddish brown, very fine grained, moderately weak, moderately narrow spaced bedding planes, rough, faintly weathered	0.61 - 2.13	77 0*
	Siltstone	0.80 - 2.13: Dark gray, fine grained, moderately weak, moderately narrow spaced bedding planes, 10 deg to core axis, rough, fresh		
2.13		End of borehole		

Drilling Report

JOB P8186.00
HOLE B81
SHEET 1 OF 4

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 10:30 Sept. 16, 1987
FINISHED 13:00 Sept. 16, 1987

METHOD OF DRILLING: SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 3.35 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM 0.3 m
GROUND SURFACE -1.04 m
ROCK SURFACE -4.39 m
BOTTOM OF HOLE -5.92 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles with some coal tar, very soft	AQ	1A	51	0.00 - 0.61	41	P
			AQ	2	51	0.61 - 1.22	48	P
			AQ	3	51	1.22 - 1.83	33	P
2.0	Gravelly silt	Dark brown gravelly silt, some fine sand trace clay, very dense, low plasticity (till)	AQ	4	51	1.83 - 2.44	53	0/15 cm 50 29 22
			AS	5	51	2.44 - 3.05	43	17 29 27 50/58 cm

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED
LOGGED BY J. A. MacLeod, B. G. Bennett
DATE March, 1988

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ACRES

Drilling Report

JOB P8186.00
HOLE B81
SHEET 2 OF 4

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
	Gravelly silt (cont)		AS	6	51	3.05 - 3.35	23	16 86/31 cm
3.35	Bedrock	For description, see following sheet						

ACRES

Drilling Report

JOB P8186.00
HOLE B81
SHEET 3 OF 4

Depth	Rock Type	Description	Depth of Run (m)	Core Rec'y and RQD*
0.00	Overburden	For description, see previous sheets		
3.35	Siltstone	Light greenish gray, fine grained, weak, highly weathered	3.35 - 4.88	8 0*
4.88		End of borehole		

ACRES

Drilling Report

JOB P8186.00
HOLE B81
SHEET 4 OF 4

Notes:

1 - Additional contaminated samples collected adjacent to borehole.

Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)
AQ	1A	51	0.00 - 0.61	41
AQ	3A	51	1.22 - 1.83	41

Drilling Report

JOB P8186.00
HOLE B82
SHEET 1 OF 3

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 14:00 Sept. 16, 1987
FINISHED 15:30 Sept. 16, 1987

METHOD OF DRILLING:
SOIL NW wash bored casing
ROCK BV double tubed core barrel

CASING DIAM 89 mm O.D. to 2.13 m
CORE DIAM 48 mm

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadain Geodetic

DRILLING PLATFORM	0.5 m
GROUND SURFACE	-2.29 m
ROCK SURFACE	-3.89 m
BOTTOM OF HOLE	-5.64 m
WATER LEVEL	

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Silt with coke/coal	Black heterogeneous mixture of silts and coke/coal particles, very soft	AQ	1	51	0.00 - 0.91		P (note 2)
0.9	Gravelly sand	Dark grayish brown gravelly sand, some silt, dense, low plasticity (till)	AQ	2	51	0.91 - 1.52	53	17 22 23 43
1.6	Bedrock	For description, see following sheet	AS	3	51	1.52 - 2.13	36	9 24 56 56

SAMPLING METHOD
*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER
N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
APPROVED M. J. Bambrick
LOGGED BY J. A. MacLeod, B. G. Bennett
DATE March, 1988

Form 318 A (1)

ACRES

Drilling Report

JOB P8186.00
HOLE B82
SHEET 2 OF 3

Depth	Rock Type	Description	Depth of Run	Core Rec'y and RQD*
0.00	Overburden	For description, see previous sheet		
1.6	Siltstone	Dark brownish to greenish gray, fine grained, moderately strong, highly weathered becoming fresh with depth	2.13 - 3.35	52 21*
3.35		End of borehole		

Drilling Report

JOB P8186.00
HOLE B83
SHEET 1 OF 1

CLIENT Nova Scotia Department of the Environment
PROJECT Sydney Tar Ponds Clean Up
SITE Muggah Creek
CONTRACTOR: Logan Geotech Inc.

STARTED 17:30 Sept. 29, 1987
FINISHED 18:00 Sept. 29, 1987

METHOD OF DRILLING: SOIL By hand
ROCK N/a

CASING DIAM N/a
CORE DIAM N/a

LOCATION: See borehole plan
BEARING N/a
INITIAL DIP Vertical
OTHER DIPS N/a

ELEVATIONS: DATUM Canadian Geodetic
DRILLING PLATFORM N/a
GROUND SURFACE 0.18m
ROCK SURFACE N/a
BOTTOM OF HOLE -0.89 m
WATER LEVEL

Depth (m)	Soil Type	Description	Sample Type*	No.	Size (mm)	Depth (m)	Ret'd (cm)	Penetration Test
0.0	Sand with coke/coal	Black heterogeneous mixture of fine sands and coke/coal particles with some coal tar, very loose	AQ	1	51	0.00 - 0.61	53	P
			AQ	2	51	0.61 - 1.07	31	P
1.07		End of borehole						

SAMPLING METHOD

*A – split tube
B – thin wall tube
C – piston sampler
D – core barrel
E – auger
F – wash

SHIPPING CONTAINER

N – insert
O – tube
P – water content tin
Q – glass jar
R – cloth bag
S – plastic bag
Y – core box
Z – discarded

INSPECTOR J. A. MacLeod
LOGGED BY J. A. MacLeod

APPROVED
DATE March, 1988

Form 318 A (1)

APPENDIX B

CHEMICAL TEST RESULTS

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-101-C		
Sample ID	STP-0001	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.30	naphthalene	953
3,4-dimethylpyridine	0.08	fluoranthene	316
,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	107
methylated benzocarbazoles	1.44	indeno[1,2,3-cd]pyrene	3.3
methylated benzoacridines	2.68	dibenz[a,h]anthracene	4.05
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	11
2,4-dimethylquinoline	4.04	acenaphthylene	149
carbazole	2.18	anthracene	460
benzonitrile	< 0.01	chrysene	44
cyanonaphthalene	< 0.01	benzo[a]pyrene	79
?-methylquinoline	2.57	benzo[e]pyrene	----
4-methylquinoline	0.61	pyrene	270
7-methylquinoline	0.48	acenaphthene	130
2,6-dimethylquinoline	2.15	phenanthrene	526
acridine	9.38	triphenylene	577
quinoline	0.37	benzo[a]anthracene	241
benzacridines	5.94	benzo[ghi]perylene	1.37
isoquinoline	0.28	fluorene	386
benzocarbazole	9.96		
7,8-benzoquinoline	4.57	benzoquinoline	4.78
dimethylquinoline	1.63	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-102-C		
Sample ID	STP-0002	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.28	naphthalene	211
3,4-dimethylpyridine	0.18	fluoranthene	180
3,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	105
methylated benzocarbazoles	1.89	indeno[1,2,3-cd]pyrene	36.0
methylated benzoacridines	7.24	dibenz[a,h]anthracene	3.00
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	3
2,4-dimethylquinoline	0.96	acenaphthylene	8
carbazole	1.76	anthracene	69
benzonitrile	< 0.01	chrysene	26
cyanonaphthalene	< 0.01	benzo[a]pyrene	66
3-methylquinoline	0.86	benzo[e]pyrene	----
4-methylquinoline	0.24	pyrene	169
7-methylquinoline	0.12	acenaphthene	50
2,6-dimethylquinoline	0.55	phenanthrene	121
acridine	12.73	triphenylene	50
quinoline	0.74	benzo[a]anthracene	151
benzacridines	12.52	benzo[ghi]perylene	2.10
isoquinoline	0.51	fluorene	52
benzocarbazole	22.93		
7,8-benzoquinoline	6.16	benzoquinoline	5.74
dimethylquinoline	0.51	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-103-C		
Sample ID	STP-0003	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	2.79	naphthalene	17020
3,4-dimethylpyridine	0.16	fluoranthene	487
,5-dimethylpyridine	0.10	benzo[b]fluoranthene	218
methylated benzocarbazoles	2.29	indeno[1,2,3-cd]pyrene	62.8
methylated benzoacridines	1.02	dibenz[a,h]anthracene	1.10
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	11
2,4-dimethylquinoline	2.38	acenaphthylene	232
carbazole	4.13	anthracene	568
benzonitrile	< 0.01	chrysene	84
cyanonaphthalene	< 0.01	benzo[a]pyrene	141
-methylquinoline	3.34	benzo[e]pyrene	----
4-methylquinoline	1.45	pyrene	518
7-methylquinoline	1.02	acenaphthene	106
2,6-dimethylquinoline	1.37	phenanthrene	704
acridine	16.89	triphenylene	78
quinoline	4.37	benzo[a]anthracene	394
benzacridines	22.71	benzo[ghi]perylene	6.90
isoquinoline	1.60	fluorene	431
benzocarbazole	11.80		
7,8-benzoquinoline	11.23	benzoquinoline	8.64
dimethylquinoline	< 0.01	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-104-C	Date Reported	25-Nov-8
Sample ID	STP-0004	Date Submitted	03-Nov-8
Matrix	Sediment		

HNC		PAH	
2,4-dimethylpyridine	2.43	naphthalene	16640
3,4-dimethylpyridine	0.25	fluoranthene	1180
,5-dimethylpyridine	0.07	benzo[b]fluoranthene	694
methylated benzocarbazoles	19.39	indeno[1,2,3-cd]pyrene	188.0
methylated benzoacridines	1127.00	dibenz[a,h]anthracene	1.10
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	29
2,4-dimethylquinoline	10.84	acenaphthylene	1320
carbazole	6.03	anthracene	1460
benzonitrile	< 0.01	chrysene	255
cyanonaphthalene	< 0.01	benzo[a]pyrene	446
-methylquinoline	4.68	benzo[e]pyrene	----
4-methylquinoline	1.14	pyrene	1310
7-methylquinoline	0.68	acenaphthene	90
2,6-dimethylquinoline	3.30	phenanthrene	1780
acridine	48.19	triphenylene	223
quinoline	1.78	benzo[a]anthracene	1084
benzacridines	132.90	benzo[ghi]perylene	7.30
isoquinoline	1.13	fluorene	1050
benzocarbazole	118.50		
7,8-benzoquinoline	40.88	benzoquinoline	15.70
dimethylquinoline	1.33	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-105-C		
Sample ID	STP-0005	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	1.90	naphthalene	651
3,4-dimethylpyridine	0.33	fluoranthene	288
,5-dimethylpyridine	0.17	benzo[b]fluoranthene	93
methylated benzocarbazoles	15.90	indeno[1,2,3-cd]pyrene	1.7
methylated benzoacridines	13.84	dibenz[a,h]anthracene	2.40
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	3
2,4-dimethylquinoline	8.25	acenaphthylene	104
carbazole	2.45	anthracene	325
benzonitrile	< 0.01	chrysene	38
cyanonaphthalene	< 0.01	benzo[a]pyrene	61
-methylquinoline	8.91	benzo[e]pyrene	----
4-methylquinoline	1.88	pyrene	241
7-methylquinoline	1.40	acenaphthene	32
2,6-dimethylquinoline	3.92	phenanthrene	381
acridine	13.57	triphenylene	323
quinoline	2.33	benzo[a]anthracene	239
benzacridines	68.36	benzo[ghi]perylene	1.70
isoquinoline	1.27	fluorene	189
benzocarbazole	55.88		
7,8-benzoquinoline	16.78	benzoquinoline	21.01
dimethylquinoline	3.69	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-106-C		
Sample ID	STP-0006	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.91	naphthalene	2370
3,4-dimethylpyridine	0.18	fluoranthene	327
5-dimethylpyridine	0.05	benzo[b]fluoranthene	49
methylated benzocarbazoles	2.62	indeno[1,2,3-cd]pyrene	37.4
methylated benzoacridines	6.56	dibenz[a,h]anthracene	6.70
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	6
2,4-dimethylquinoline	1.45	acenaphthylene	106
carbazole	2.24	anthracene	296
benzonitrile	< 0.01	chrysene	47
cyanonaphthalene	< 0.01	benzo[a]pyrene	98
methylquinoline	1.13	benzo[e]pyrene	----
4-methylquinoline	0.41	pyrene	321
7-methylquinoline	0.23	acenaphthene	21
2,6-dimethylquinoline	0.79	phenanthrene	392
acridine	2.17	triphenylene	811
quinoline	0.61	benzo[a]anthracene	267
benzacridines	11.67	benzo[ghi]perylene	5.90
isoquinoline	0.51	fluorene	26
benzocarbazole	6.22		
7,8-benzoquinoline	6.89	benzoquinoline	7.46
dimethylquinoline	0.94	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-107-C		
Sample ID	STP-0007	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.26	naphthalene	443
3,4-dimethylpyridine	0.07	fluoranthene	199
,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	54
methylated benzocarbazoles	6.21	indeno[1,2,3-cd]pyrene	11.6
methylated benzoacridines	4.92	dibenz[a,h]anthracene	0.80
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	3
2,4-dimethylquinoline	3.10	acenaphthylene	14
carbazole	0.32	anthracene	323
benzonitrile	< 0.01	chrysene	26
cyanonaphthalene	< 0.01	benzo[a]pyrene	37
-methylquinoline	1.18	benzo[e]pyrene	----
4-methylquinoline	0.65	pyrene	178
7-methylquinoline	0.21	acenaphthene	157
2,6-dimethylquinoline	1.51	phenanthrene	413
acridine	10.62	triphenylene	221
quinoline	0.64	benzo[a]anthracene	137
benzacridines	13.47	benzo[ghi]perylene	3.70
isoquinoline	0.47	fluorene	273
benzocarbazole	20.65		
7,8-benzoquinoline	4.52	benzoquinoline	3.97
dimethylquinoline	1.30	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-108-C		
Sample ID	STP-0008	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.46	naphthalene	236
3,4-dimethylpyridine	< 0.01	fluoranthene	46
,,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	17
methylated benzocarbazoles	2.27	indeno[1,2,3-cd]pyrene	0.9
methylated benzoacridines	1.34	dibenz[a,h]anthracene	< 1
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	0
2,4-dimethylquinoline	1.95	acenaphthylene	22
carbazole	1.00	anthracene	59
benzonitrile	< 0.01	chrysene	5
cyanonaphthalene	< 0.01	benzo[a]pyrene	11
-methylquinoline	0.86	benzo[e]pyrene	----
4-methylquinoline	0.61	pyrene	35
7-methylquinoline	0.53	acenaphthene	14
2,6-dimethylquinoline	1.15	phenanthrene	62
acridine	4.37	triphenylene	293
quinoline	0.49	benzo[a]anthracene	28
benzacridines	1.87	benzo[ghi]perylene	< 1
isoquinoline	0.31	fluorene	50
benzocarbazole	8.62		
7,8-benzoquinoline	2.79	benzoquinoline	2.91
dimethylquinoline	2.02	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-109-C		
Sample ID	STP-0009	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.48	naphthalene	854
3,4-dimethylpyridine	0.10	fluoranthene	252
3,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	30
methylated benzocarbazoles	1.66	indeno[1,2,3-cd]pyrene	25.0
methylated benzoacridines	3.56	dibenz[a,h]anthracene	8.60
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	6
2,4-dimethylquinoline	1.20	acenaphthylene	78
carbazole	1.02	anthracene	374
benzonitrile	< 0.01	chrysene	38
cyanonaphthalene	< 0.01	benzo[a]pyrene	62
-methylquinoline	0.81	benzo[e]pyrene	----
4-methylquinoline	0.60	pyrene	243
7-methylquinoline	0.17	acenaphthene	27
2,6-dimethylquinoline	0.58	phenanthrene	377
acridine	4.40	triphenylene	----
quinoline	0.33	benzo[a]anthracene	197
benzacridines	10.00	benzo[ghi]perylene	8.80
isoquinoline	0.27	fluorene	188
benzocarbazole	7.90		
7,8-benzoquinoline	2.73	benzoquinoline	2.42
dimethylquinoline	0.61	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-110-C		
Sample ID	STP-0010	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	3.04	naphthalene	558
3,4-dimethylpyridine	0.34	fluoranthene	200
,5-dimethylpyridine	0.09	benzo[b]fluoranthene	89
methylated benzocarbazoles	2.00	indeno[1,2,3-cd]pyrene	23.7
methylated benzoacridines	3.18	dibenz[a,h]anthracene	7.70
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	7
2,4-dimethylquinoline	2.79	acenaphthylene	44
carbazole	8.42	anthracene	193
benzonitrile	< 0.01	chrysene	30
cyanonaphthalene	< 0.01	benzo[a]pyrene	64
-methylquinoline	2.84	benzo[e]pyrene	----
4-methylquinoline	0.68	pyrene	191
7-methylquinoline	0.56	acenaphthene	15
2,6-dimethylquinoline	1.56	phenanthrene	239
acridine	9.48	triphenylene	----
quinoline	1.02	benzo[a]anthracene	161
benzacridines	13.31	benzo[ghi]perylene	23.70
isoquinoline	0.61	fluorene	126
benzocarbazole	10.24		
7,8-benzoquinoline	4.02	benzoquinoline	4.21
dimethylquinoline	1.75	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-111-C		
Sample ID	STP-0011	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.04	naphthalene	1095
3,4-dimethylpyridine	< 0.01	fluoranthene	144
-,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	71
methylated benzocarbazoles	0.85	indeno[1,2,3-cd]pyrene	22.4
methylated benzoacridines	1.51	dibenz[a,h]anthracene	1.20
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	3
2,4-dimethylquinoline	0.30	acenaphthylene	5
carbazole	0.24	anthracene	78
benzonitrile	< 0.01	chrysene	16
cyanonaphthalene	< 0.01	benzo[a]pyrene	52
-methylquinoline	0.13	benzo[e]pyrene	----
4-methylquinoline	0.38	pyrene	135
7-methylquinoline	0.09	acenaphthene	19
2,6-dimethylquinoline	0.17	phenanthrene	121
acridine	4.26	triphenylene	< 1
quinoline	0.16	benzo[a]anthracene	155
benzacridines	10.14	benzo[ghi]perylene	31.20
isoquinoline	0.05	fluorene	48
benzocarbazole	5.41		
7,8-benzoquinoline	1.68	benzoquinoline	1.54
dimethylquinoline	0.22	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-112-C		
Sample ID	STP-0012	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	0.67	naphthalene	1951
3,4-dimethylpyridine	0.07	fluoranthene	174
,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	43
methylated benzocarbazoles	1.25	indeno[1,2,3-cd]pyrene	6.1
methylated benzoacridines	1.27	dibenz[a,h]anthracene	< 1
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	2
2,4-dimethylquinoline	1.07	acenaphthylene	18
carbazole	0.85	anthracene	132
benzonitrile	< 0.01	chrysene	16
cyanonaphthalene	< 0.01	benzo[a]pyrene	28
-methylquinoline	1.02	benzo[e]pyrene	----
4-methylquinoline	0.72	pyrene	152
7-methylquinoline	0.28	acenaphthene	26
2,6-dimethylquinoline	0.53	phenanthrene	187
acridine	2.03	triphenylene	< 1
quinoline	0.79	benzo[a]anthracene	94
benzacridines	8.31	benzo[ghi]perylene	9.30
isoquinoline	0.45	fluorene	66
benzocarbazole	8.74		
7,8-benzoquinoline	7.04	benzoquinoline	3.46
dimethylquinoline	1.08	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

OceanChem Labs

Sydney Tar Ponds Clean Up

Client ID	TPM-113-C		
Sample ID	STP-0013	Date Reported	25-Nov-8
Matrix	Sediment	Date Submitted	03-Nov-8

HNC		PAH	
2,4-dimethylpyridine	< 0.01	naphthalene	208
3,4-dimethylpyridine	< 0.01	fluoranthene	106
,5-dimethylpyridine	< 0.01	benzo[b]fluoranthene	41
methylated benzocarbazoles	0.30	indeno[1,2,3-cd]pyrene	5.4
methylated benzoacridines	< 0.01	dibenz[a,h]anthracene	< 1
9-anthracene carbonitrile	< 0.01	benzo[k]fluoranthene	2
2,4-dimethylquinoline	0.14	acenaphthylene	10
carbazole	0.09	anthracene	65
benzonitrile	< 0.01	chrysene	12
cyanonaphthalene	< 0.01	benzo[a]pyrene	25
-methylquinoline	0.04	benzo[e]pyrene	----
4-methylquinoline	0.23	pyrene	93
7-methylquinoline	< 0.01	acenaphthene	14
2,6-dimethylquinoline	0.04	phenanthrene	100
acridine	0.86	triphenylene	< 1
quinoline	0.11	benzo[a]anthracene	66
benzacridines	5.57	benzo[ghi]perylene	11.20
isoquinoline	< 0.01	fluorene	36
benzocarbazole	4.12		
7,8-benzoquinoline	2.77	benzoquinoline	1.28
dimethylquinoline	< 0.01	anthracene carbonitrile	< 0.01

All values in mg/Kg unless otherwise stated

APPENDIX C

THERMAL TEST RESULTS

CALORIFIC ANALYSES OF SEDIMENTS BY NRC (1985)

Sample Number	After Drying at 108°C Overnight			After Dean and Stark Soxhlet Extraction					
	Weight Loss (%)	Ash Dry Bases (%)	Dry Bases (Btu/lb)	Water (%)	Solids (%)	Oils (%)	Oil Dry Bases (%)	Ash Dry Bases (%)	Dry Based (Btu/lb)
7154-B0-4	27.11	84.03	1 121	28.67	70.69	0.64	0.90	78.49	533
B2 4.0 to 6.0 ft	-	79.51	347	37.26	62.08	0.66	1.06	85.01	722
7154-B0-9	56.12	43.95	7 637	57.98	39.38	2.64	6.69	42.77	7 064
B5 2.5 to 4.6 ft	-	43.43	7 305	60.02	39.67	0.31	0.77	42.12	6 993
7154-B0-10	59.5	36.05	8 564	60.89	34.62	4.49	12.97	39.5	7 815
12, 14, 15	-	35.84	8 341	61.75	36.71	1.54	4.21	37.54	8 149
B5 4.5 to 13.5 ft									
7154-B0-16	44.99	36.39	8 805	45.33	50.33	4.34	8.61	34.31	9 406
B4 6.0 to 8.0 ft	-	39.10	8 688	43.16	54.89	1.95	3.56	42.11	8 452
7154-B0-18	33.2	16.05	12 346	37.16	59.73	3.11	5.20	16.29	12 443
B6 0 - 2.0 ft	-	14.14	12 377	32.89	61.44	5.67	9.23	18.66	12 350
			12 598						
7154-B0-19	21.62	97.23	0	23.83	76.98	0	0	96.76	0
B6 2.0 to 3.5 ft	-	97.71	0	22.20	78.39	0	0	97.98	0
7154-B0-21	23.08	21.32	12 030	18.38	52.93	28.69	54.2	30.57	10 316
B7 4.0 to 5.7 ft	-	20.43	11 904	22.10	55.88	22.02	39.39	35.56	9 468
7154-B0-29	36.67	16.86	12 168	39.66	58.79	1.55	2.64	19.75	11 545
B8 4.0 - 6.0 ft	-	16.55	11 997	38.95	61.08	0	0	16.45	12 361
7154-B0-36	34.12	6.68	13 566	40.27	42.28	0	0	8.01	3 847
B9 4.0 - 6.0 ft	-	5.84	13 957	37.09	65.78	0	0	7.35	13 732
7154-B0-40	30.86	30.54	10 865	25.72	61.39	12.91	21.03	35.89	9 443
B11 0.0 - 2.0 ft	-	27.28	10 167	21.43	66.62	11.95	17.94	32.68	8 754
7154-B0-44	31.83	25.85	10 451	32.49	63.51	4.0	6.30	29.98	11 252
P2 2.0 - 4.0 ft	-	24.80	10 626	35.67	63.93	0.40	0.64	23.40	1 304
			10 638						
7154-B0-46	35.28	20.83	11 507	38.12	61.17	0.71	2.92	23.92	11 172
P3 0.0 - 3.0 ft	-	20.73	11 878	29.21	65.68	5.11	7.78	25.54	10 536

NOVA SCOTIA RESEARCH FOUNDATION CORPORATION
Box 790, 100 Fenwick Street
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ACRES INTERNATIONAL LTD.
SYDNEY TAR POND SAMPLES

Samples Rec'd.: Nov. 4/87
Reported: Nov. 20/87

Lab No.	Acres Sample No.	% Air Dried[1] Moisture	% Moisture (ASTM D3173)	% Ash	% Total Sulphur	% C	% H	% N	% Volatiles	BTU/lb[3]	% Oxygen (By Diff.)	% Fixed Carbon
R906/1	TPH-101	32.88	1.47	32.10	2.95	58.99	3.38	0.76	25.76	10,165	1.82	40.67
/2	-102	26.30	1.36	19.33	1.45	70.78	4.44	1.32	31.04	12,332	2.68	48.27
/3	-103	39.58	2.21	22.69	2.75	62.04	3.96	1.02	32.38	11,268	7.54	42.72
/4	-104	10.64	2.27	38.71	1.57	52.06	3.17	0.48	26.73	9,282	4.01	32.29
/5	-105	19.57	1.07	63.71	1.22	26.79	1.74	0.25	17.23	5,351	6.29	17.99
/6	-106	34.27	2.49	32.46	3.39	57.02	3.51	0.85	28.14	9,929	2.77	36.91
/7	-107	46.81	9.57	33.51	2.01	49.95	3.09	0.82	25.90	8,498	10.62	31.02
/8	-108	37.99	1.81	21.33	2.30	68.85	4.01	0.91	30.12	11,599	2.60	46.74
/9	-109	16.57	1.06	67.91	1.00	23.38	1.49	0.40	15.42	4,261	5.82	15.61
/10	-110	49.56	3.19	32.79	3.57	52.18	3.61	0.91	31.28	9,900	6.94	32.74
/11	-111	48.43	2.44	70.68	2.35	21.10	1.60	0.40	18.27	3,041	3.87	8.61
/12	-112	52.37	3.31	36.25	3.31	47.55	3.50	0.96	33.20	8,510	8.43	27.24
/13	-113	60.63	3.94	45.92	4.15	38.22	3.28	0.64	29.07	6,870	7.79	21.07

Lab No.	ppm F	ppm Hg	% Cl^-	% Total Carbon (Leco)	% Inorganic Carbon	% Total Nitrogen (ASTM D3179)
R906/8	156	1.4	0.65	67.54	2.28	1.07

Quality Control[2] (Duplicates with NBS Certified Values in Brackets)

% Moisture	% Ash	% Volatile Matter	% Total Sulphur	% Total Nitrogen ASTM D3179	BTU/lb
1.27 (1.3)	6.66 (6.79 ± 0.16)	35.96 (35.4 ± 1.1)	1.80 (1.89 ± 0.06)	1.52 (1.56 ± 0.07)	12,578 (12,550 ± 160)
1.24	6.60	35.94	1.82		12,454

% Carbon CHN Analyzer	% Nitrogen CHN Analyzer	% Hydrogen CHN Analyzer	% Carbon (Leco Carbon Analyzer)	ppm Hg
79.00 (78.11 ± 0.37)	1.49 (1.56 ± 0.07)	4.91 (5.07 ± 0.06)	77.76 (78.11 ± 0.37)	0.13 (0.13, 0.14)
78.64	1.33	4.60		0.16

Notes: 1. All results are reported on air-dried basis.
2. Controls are NBS - certified standard reference materials.
3. BTU values are corrected for acid & sulphur.

J. William Thorpe

J.W. Thorpe, Ph.D., Director
Analytical & Environmental Chemistry Section
November 23, 1987